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For:	METHOD FOR MANUFACTURING	)
	SEMICONDUCTOR DEVICE	)

VERIFICATION OF TRANSLATION

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Sir:

I, Asami Maruyama, C/O Semiconductor Energy Laboratory Co., Ltd. 398, Hase, Atsugi-shi, Kanagawa-ken 243-0036 Japan, a translator, herewith declare:

that I am well acquainted with both the Japanese and English Languages;

that I am the translator of the attached English translation of the Japanese Patent Application No. 2004-017608 filed on January 26, 2004; and

that to the best of my knowledge and belief the following is a true and correct English translation of the Japanese Patent Application No. 2004-017608 filed on January 26, 2004.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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[List of Attachment]

[Attachment] Scope of Claims 1

[Attachment] Specification 1

[Attachment] Drawing 1

[Attachment] Abstract 1

[Name of Document] Scope of Claims

[Claim 1]

A method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a first conductive film pattern by discharging a conductive film material containing a photosensitive material over a substrate having an insulating surface by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light;

a step of forming a second conductive film pattern having a narrower width than that of the first conductive film pattern by developing the exposed first conductive film pattern;

a step of forming a gate insulating film covering the second conductive film pattern; and

a step of forming a semiconductor film over the gate insulating film.

[Claim 2]

A method for manufacturing a light-emitting device according to claim 1, characterized in that the conductive film material containing a photosensitive material comprises a compound or an elementary substance of Ag, Au, Cu, Ni, Al or Pt.

[Claim 3]

A method for manufacturing a light-emitting device according to claim 1 or claim 2, wherein the photosensitive material is a negative type photosensitive material.

[Claim 4]

A method for manufacturing a light-emitting device according to claim 1 or claim 2, wherein the photosensitive material is a positive type photosensitive material.

[Claim 5]

A method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a gate electrode over a surface of a substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a positive type photosensitive material over the second semiconductor film by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light from a surface side of the substrate;

a step of forming a source electrode and a drain electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Claim 6]

A method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a gate electrode over a surface of a substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a negative type photosensitive material over the second semiconductor film by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by emitting the laser light from a reverse surface side of the substrate using the gate electrode as a mask;

a step of forming a source electrode and a drain electrode in a self-alignment manner to have a space that is the same as a width of the gate electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Claim 7]

A light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, comprising:

a gate wiring or a gate electrode over a substrate having an insulating surface;

a gate insulating film formed over the gate wiring or the gate electrode;

a semiconductor layer including a channel formation region over the gate insulating film;

a source electrode or a drain electrode formed over the semiconductor layer, and

a cathode or an anode formed over the source electrode or the drain electrode,

characterized in that the channel formation region has a channel length that is the same as a width of the gate electrode and the gate electrode is the same as a space between the source electrode and the drain electrode.

[Claim 8]

A light-emitting device according to claim 7, characterized in that an active layer of the thin film transistor is a non single crystalline semiconductor film to which hydrogen or a hydrogen halide is added or a polycrystalline semiconductor film.

[Claim 9]

A light-emitting device according to claim 7 or claim 8, characterized in that the source electrode or the drain electrode contains a photosensitive material.

[Claim 10]

An electronic appliance, characterized in that the light-emitting device according to any one of claims 7 to 9 is an image-voice two-way communication device or a versatile remote control device.

[Name of Document] Specification

[Title of Invention] ELECTRIC APPLIANCE, LIGHT EMITTING DEVICE, AND METHOD FOR MANUFACTURING THE SAME

[Technical Field]

[0001]

The present invention relates to a semiconductor device and a method for

manufacturing the semiconductor device having a circuit composed of thin film transistors (hereinafter, TFT). In particular, the present invention relates to an electric appliance installed with a light-emitting display device having an organic light-emitting element as a component.

[0002]

Note that the semiconductor device in this specification refers to a device in general that can operate by utilizing semiconductor characteristics, and an electro-optic device, a semiconductor circuit, and an electric appliance are all semiconductor devices.

[Background Art]

[0003]

In recent years, study of a light-emitting device having an EL element as a self luminous light-emitting element has been activated. The light-emitting device is also referred to as an organic EL display or an organic light-emitting diode. These light-emitting devices have attracted attention as a new generation cellular phone, a personal digital assistance (PDA), or a next generation display for their characteristics of high response speed that is suitable for movie display; low voltage; low power consuming driving; and the like.

[0004]

An EL element in which a layer containing an organic compound serves as a light-emitting layer has a structure in which the layer containing an organic compound (hereinafter, referred to as an EL layer) is interposed between an anode and a cathode. Upon applying electric field to the anode and the cathode, light is emitted from the EL layer (Electro Luminescence). In addition, light emission from the EL element includes light emission (fluorescence) that occurs in returning from the singlet excited state back down to the ground state and light emission (phosphorescence) that occurs in returning from the triplet excited state back down to the ground state.

[0005]

The range of application of an active matrix display device is increased, and demands for higher definition, higher aperture ratio, and higher reliability have been increasing in accordance with increase of screen size.

[0006]

In Patent Document 1, a large display can be realized by forming one display

screen composed of a plurality of tiled panels. However, the large display requires high costs and a unique driving method since a plurality of panels is used.

[0007]

In addition, simultaneously with increasing the screen size, requirements of improvement of productivity and reduction in costs have been increased.

[0008]

In addition, Patent Document 2 discloses technique for forming a film over a semiconductor wafer by using a device that can deliver continuously resist solution from a nozzle in the form of a line having a thin diameter to improve the yield of the liquid used for film formation.

[Patent Document 1] Unexamined patent publication No. 2000-298446

[Patent Document 2] Unexamined patent publication No. 2000-188251

[Disclosure of the Invention]

[Problems to be solved by the Invention]

[0009]

In the present circumstances, a film formation method of using a spin coating method is heavily used in a manufacturing process. When the substrate size is further increased in a future, the film formation method of using a spin coating method becomes a disadvantage in mass production since a mechanism for rotating a large substrate becomes large and there is much loss of material solution and waste liquid. In addition, in the case that a rectangular substrate is spin coated, a coated film tends to have circular unevenness, with a rotation axis as a center. The present invention provides a manufacturing process using a droplet discharging method that is suitable for a large substrate in mass production.

[0010]

In addition, the present invention provides a large screen display using a wiring formed by a droplet discharging method and the manufacturing method thereof. In addition, the present invention provides a light-emitting device in which a wiring is formed by a droplet discharging method to have a desired electrode width and a TFT having a channel length of 10 μm or less is arranged in a pixel.

[Means for solving the Problems]

[0011]

According to the present invention, a microscopic wiring pattern can be realized by discharging selectively photosensitive conductive film material solution by a droplet discharging method, exposing selectively to laser light or the like, and developing. The present invention can reduce drastically costs since a patterning process can be shortened and an amount of material which is used can be reduced in a process of forming a conductive pattern. Accordingly, the present invention can also be applied to a large substrate.

[0012]

The conductive film material solution contains a metal such as Ag, Au, Cu, Ni, Al, or Pt or an alloy; and photosensitive resin comprising organic high molecular resin, photo polymerization initiator, photo polymerization monomer, solvent, or the like. As the organic high molecular resin, novolac resin, acrylic based copolymer, methacrylic based copolymer, cellulose derivatives, cyclic rubber based resin, or the like can be used.

[0013]

A photosensitive material can be broadly divided into negative type and positive type. In the case of using the negative type photosensitive material, an exposed portion brings about chemical reactions, and the portion chemically reacted is only left due to developing solution, and then, a pattern is formed. In the case of using the positive type photosensitive material, an exposed portion brings about chemical reactions, and the portion chemically reacted is dissolved due to developing solution, then, unexposed portion is only left, and then, a pattern is formed.

[0014]

Further, since the wiring width is determined by accuracy of laser light irradiation, a desired wiring width can be obtained irrespective of an amount or viscosity of a drop or nozzle diameter. Generally, the wiring width is varied by a contact angle between material solution discharged from a nozzle and a substrate. For example, an amount discharged from a nozzle having a diameter (50 μm×50 μm) of a typical ink jet device is 30 pl ~ 200 pl, and an obtained wiring width is 60 μm ~ 300 μm. A wiring having a narrow width (for example, an electrode width of 3 μm to 10 μm) can be obtained by laser light exposure according to the present invention. An amount discharged from a nozzle having a thinner diameter than that of a typical nozzle is 0.1 pl

~ 40 pl, and an obtained wiring width is 5 μm ~ 100 μm.

[0015]

In addition, in the case of forming a wiring pattern by a droplet discharging method, there are both the case where drops of a conductive material may be discharged intermittently from a nozzle in the form of a dot, and the case where the material may be discharged continuously from a nozzle and attached while being kept continuous in the form of a ribbon. In the present invention, a wiring pattern may be appropriately formed by any one of the above. In the case of forming a wiring pattern having a comparatively large width, the case that the material is attached while being kept continuous in the form of a ribbon by being discharged continuously from a nozzle leads to better productivity.

[0016]

Further, before forming a wiring pattern by a droplet discharging method, a base layer for improving adhesiveness is preferably formed (or base pretreatment is preferably performed) over a whole surface or a selected area of a substrate in advance. As formation of a base layer, treatment such that a photocatalyst substance (titanium oxide (TiO_X), strontium titanate ($SrTiO_3$), cadmium selenide (CdSe), potassium tantalate ($KTaO_3$), cadmium sulfide (CdS), zirconium oxide (ZrO_2), niobium oxide (Nb_2O_5), zinc oxide (ZnO), iron oxide (Fe_2O_3), or tungsten oxide (WO_3)) is dropped over the whole surface by a spraying method or a sputtering method may be performed. Alternatively, treatment such that an organic material (a coated insulating film using polyimide, acrylic, or a material which has a skeleton formed by the bond of silicon (Si) and oxygen (O), and which includes at least one of hydrogen, fluorine, an alkyl group, and aromatic hydrocarbon as the substituent) is selectively formed by an ink jetting method or a sol-gel method may be performed.

[0017]

A photocatalyst substance refers to a substance having a photocatalyst function that yields photocatalyst activity by being irradiated with light in an ultraviolet region (wavelength of 400 nm or less, preferably, 380 nm or less). If a conductor mixed into solvent is discharged by a droplet discharging method as typified by an ink jetting method over a photocatalyst substance, a microscopic drawing can be realized.

[0018]

For example, before emitting light to TiO_X, TiO_X has a lipophilic property but no hydrophilic property, that is, the TiO_X is in a state having water-shedding quality. By light irradiation, TiO_X brings about photocatalyst activity and loses a lipophilic property but has a hydrophilic property. Further, TiO_X is capable of having both of a lipophilic property and a hydrophilic property depending on light irradiation time.

[0019]

Further, by adding a transition metal (Pd, Pt, Cr, Ni, V, Mn, Fe, Ce, Mo, W, and the like) into a photocatalyst substance by doping, photocatalyst activity can be improved or photocatalyst activity can be yielded due to light in a visible light region (wavelength of 400 nm ~ 800 nm). Since light wavelength can be determined by a photocatalyst substance as described above, light irradiation refers to emission of light of a wavelength that can yield photocatalyst activity of a photocatalyst substance.

[0020]

In addition, a conductor mixed into solvent can be discharged by a droplet discharging method as typified by an ink jetting method while light irradiation.

[0021]

In addition, after forming a photocatalyst substance that can bring about photocatalyst activity due to a wavelength of laser light over a whole surface, only an irradiated region can be modified by emitting selectively laser light to the photocatalyst substance. Further, a conductor mixed into solvent can be discharged by a droplet discharging method as typified by an ink jetting method while laser light irradiation.

[0022]

Note that a hydrophilic property refers to a property of being easier to be wet by water. A super hydrophilic property refers to the state of having a contact angle of 30° or less, especially, 5 ° or less. On the other hand, a water-shedding property refers to a property of hardly being wet by water with a contact angle of 90° or more. Similarly, a lipophilic property refers to a state of being easier to be wet by oil, whereas an oil-shedding property refers to a state of hardly being wet by oil. Further, a contact angle means an angle formed by tangents of a drop to a formation surface at the edge of a dropped dot.

[0023]

In the case that conductive film material solution has a flow property or the

flow property is increased in baking when forming a wiring by using conductive film material solution by a droplet discharging method, there is a threat that it becomes difficult to form a microscopic pattern due to dripping. Further, in the case that a space between wirings is narrow, there is a threat that patterns are in contact with each other. According to the present invention, a microscopic pattern can be obtained by mixing a photosensitive material into conductive film material solution to be precisely exposed to laser light and developed even if a wide pattern is formed by dripping.

[0024]

For example, in manufacturing a display performing large-area display, a bus line such as a gate wiring is preferably formed to be a wiring having a wide width formed by a droplet discharging method, whereas a gate electrode is preferably formed to be a wiring having a narrow width. In this instance, a gate wiring and a first gate electrode are formed by using conductive film material solution containing a positive photosensitive material, and laser light is selectively emitted to only a portion of the first gate electrode (portion one wishes to remove), then, the laser irradiated portion is developed, so that a second gate electrode processed into thin can be formed. In the case of forming the gate wiring and the first gate electrode by using conductive film material solution containing a negative photosensitive material, laser light is selectively emitted to only a portion of the gate wiring and the first gate electrode (portion one wishes to leave), and the laser irradiated portion is developed, so that a second gate electrode processed into thin can be formed.

[0025]

In addition, not only the gate electrode of a TFT, but also a source electrode, a drain electrode, an anode of a light-emitting element, a cathode of a light-emitting element, a power source line, a lead wiring, and the like can be formed.

[0026]

In addition, depending on a wavelength of laser light, the light can pass through a glass substrate. The reverse surface of the glass substrate can be exposed to the laser light. By exposing the reverse surface of the glass substrate to light, a conductive film material at the periphery of an interface can be exposed to light in advance. Accordingly, adhesiveness between a wiring and a base layer, or adhesiveness between a wiring and a substrate can be improved.

[0027]

In addition, in the case of manufacturing a bottom gate TFT, a source electrode and a drain electrode can be formed in a self-aligning manner using a gate electrode as a mask by reverse surface exposure.

[0028]

The structure of the invention disclosed in this specification is a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, comprising:

a gate wiring or a gate electrode formed over a substrate having an insulating surface;

a gate insulating film formed over the gate wiring or the gate electrode;

a semiconductor layer including a channel formation region over the gate insulating film;

a source electrode or a drain electrode formed over the semiconductor layer; and

a cathode or an anode formed over the source electrode or the drain electrode;

characterized in that the channel formation region has a channel length that is the same as a width of the gate electrode and the gate electrode is the same as a space between the source electrode and the drain electrode.

[0029]

In addition, in the foregoing structure, an active layer of the thin film transistor is a non single crystalline semiconductor film to which hydrogen or a hydrogen halide is added, or a polycrystalline semiconductor film.

[0030]

In addition, the present invention can be applied regardless of the TFT structure. For example, a bottom gate (reverse staggered) TFT or a top gate (staggered) TFT can be used. Further, it is not limited to a single gate TFT, and a TFT may be formed to be a multigate TFT having a plurality of channel formation regions; such as a double gate TFT.

[0031]

Further, as an active layer of a TFT, an amorphous semiconductor film, a semiconductor film including a crystalline structure, a compound semiconductor film

having an amorphous structure, and the like can be appropriately used. Furthermore, as the active layer of a TFT, the semiamorphous semiconductor film (also referred to as a microcrystalline semiconductor film or a microcrystal semiconductor film) that has an intermediate structure between an amorphous structure and a crystalline structure (including single crystals and poly crystals); a stable third state with respect to free energy; and a crystalline region having a short-range order and lattice distortion can be used.

[0032]

In addition, each of the foregoing structures is characterized in that the source electrode or the drain electrode contains a photosensitive material.

[0033]

In addition, in each of the foregoing structures, the light-emitting device is an image-voice two-way communication device or a versatile remote control device as illustrated in FIG. 17 (D) as an example.

[0034]

In addition, the structure of the invention related to a manufacturing method is a method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a first conductive film pattern by discharging a conductive film material containing a photosensitive material over a substrate having an insulating surface by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light;

a step of forming a second conductive film pattern having a narrower width than that of the first conductive film pattern by developing the exposed first conductive film pattern;

a step of forming a gate insulating film covering the second conductive film pattern; and

a step of forming a semiconductor film over the gate insulating film.

[0035]

In addition, the foregoing structure is characterized in that the conductive film

material containing a photosensitive material contains a compound or an elementary substance of Ag, Au, Cu, Ni, Al, or Pt.

[0036]

In addition, the foregoing structure is characterized in that the photosensitive material is a negative type or positive type photosensitive material.

[0037]

In addition, another structure of the invention related to a manufacturing method is a method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a gate electrode over a surface of a substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a positive type photosensitive material by a droplet discharging method over the second semiconductor film;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light from a surface side of the substrate;

a step of forming a source electrode and a drain electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[0038]

In addition, another structure of the invention related to a manufacturing method is a method for manufacturing a light-emitting device having a plurality of light-emitting elements each including a cathode, a layer containing an organic compound, an anode, and a thin film transistor, characterized by comprising:

a step of forming a gate electrode over a surface of a substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a negative type photosensitive material by a droplet discharging method over the second semiconductor film;

a step of exposing the first conductive film pattern to laser light by emitting the laser light from a reverse surface side of the substrate using the gate electrode as a mask;

a step of forming a source electrode and a drain electrode in a self-aligning manner to have a space which is the same as a width of the gate electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Effect of the Invention]

[0039]

A microscopic wiring pattern can be obtained by a droplet discharging method according to the present invention. In addition, the present invention can reduce drastically costs since a patterning process can be shortened and an amount of material which is used can be reduced. Accordingly, the present invention can be applied to a large substrate.

[Best Mode for Carrying Out the Invention]

[0040]

Hereinafter, embodiments of the present invention are explained.

[0041]

(Embodiment 1)

Here, FIG. 1 and FIG. 2 illustrate an example for manufacturing an active matrix light-emitting display device having a channel etch type TFT as a switching element.

[0042]

First, a base layer 11 for improving adhesiveness between a substrate 10 and a material layer that is formed later by a droplet discharging method is formed over the

substrate 10. Since the base layer 11 may be formed to have an ultra thin thickness, the base layer is not always required to have a layered structure and considered as base pretreatment. Treatment such that a photocatalyst substance (titanium oxide (TiO_X), strontium titanate ($SrTiO_3$), cadmium selenide (CdSe), potassium tantalate ($KtaO_3$), cadmium sulfide (CdS), zirconium oxide (ZrO_2), niobium oxide (Nb_2O_5), zinc oxide (ZnO), iron oxide (Fe_2O_3), or tungsten oxide (WO_3)) is dropped over the whole surface by a spraying method or a sputtering method may be performed. Alternatively, treatment such that an organic material (a coated insulating film using polyimide, acrylic, or a material which has a skeleton formed by the bond of silicon (Si) and oxygen (O), and which includes at least one of hydrogen, fluoride, an alkyl group, and aromatic hydrocarbon as the substituent) is selectively formed by an ink jetting method or a sol-gel method may be performed.

[0043]

Here, an example in which base pretreatment for improving adhesiveness is performed in the case that a conductive material is discharged over the substrate is explained. However, the present invention is not particularly limited thereto. TiO_X depositing treatment may be performed to improve the adhesiveness between a material layer and another material layer in the case that a material layer (for example, an organic layer, an inorganic layer, or a metal layer) is formed by a droplet discharging method over another material layer (for example, an organic layer, an inorganic layer, or a metal layer) or over a discharged conductive layer. That is, in the case that a conductive material is discharged to be drawn by a droplet discharging method, it is desired that base pretreatment is interposed at the interface between an upper conductive material layer and a lower conductive material layer to improve their adhesiveness.

[0044]

Further, as the base layer 11, not only a photocatalyst material, but also 3d transition metals (Sc, Ti, Cr, Ni, V, Mn, Fe, Co, Cu, Zn, or the like), oxides thereof, nitrides thereof, or oxynitrides thereof can be used.

[0045]

Note that, as the substrate 10, in addition to a non alkali glass substrate manufactured by a fusion method or a float method such as barium borosilicate glass,

alumino borosilicate glass, or alumino silicate glass; a plastic substrate and the like having heat resistance that can resist a processing temperature of this manufacturing process can be used.

[0046]

Then, conductive film material solution is dropped by a droplet discharging method, typically, an ink jetting method to form a conductive film pattern 12 (FIG. 1 (A)). As a conductive material contained in the conductive film material solution, gold (Au), silver (Ag), copper (Cu), platinum (Pt), palladium (Pd), tungsten (W), nickel (Ni), tantalum (Ta), bismuth (Bi), lead (Pb), indium (In), tin (Sn), zinc (Zn), titanium (Ti), or aluminum (Al), alloys of the foregoing materials, dispersed nano particles of the foregoing materials, or silver halide fine particles can be used. Especially, a gate wiring preferably has low resistance. Accordingly, the gate wiring is preferably made from a material formed by solving or dispersing gold, silver, or copper into solvent in consideration of a specific resistance value. More preferably, silver or copper having low resistance is used. Further, in the case of using silver or copper, a barrier film is also provided to prevent impurities from dispersing. The solvent corresponds to esters such as butyl acetate, alcohols such as isopropyl alcohol, organic solvent such as acetone, or the like. The surface tension and viscosity are appropriately adjusted by controlling the concentration of the solvent or by adding surface-active agent or the like.

[0047]

Here, FIG. 16 illustrates an example of a droplet discharging device.

[0048]

In FIG. 16, 1500 denotes a large substrate; 1504, an imaging means; 1507, a stage; 1511, a marker; and 1503, a region where one panel is formed. Heads 1505a, 1505b, and 1505c having the same widths as that of one panel are equipped for the droplet discharging device to scan the panel by moving the stage, e.g., in zigzags or back and forth, to form appropriately a pattern of a material layer. The heads can have the same widths as that of the large substrate; however, operation becomes easier by matching the heads' widths to that of one panel as illustrated in FIG. 16. Further, to improve throughput, a material is preferably discharged while keeping the stage moving.

[0049]

In addition, the heads 1505a, 1505b, and 1505c, and the stage 1507 have preferably temperature control functions.

[0050]

Note that the space between the head (tip of a nozzle) and the large substrate is approximately 1 mm. By narrowing the space, target accuracy can be improved.

[0051]

In FIG. 16, the heads 1505a, 1505b, and 1505c brought into three lines in the scan direction may be capable of forming different layers respectively, or discharging the same materials. In the case that an interlayer insulating film is pattern formed by discharging the same materials by the three heads, the throughput is improved.

[0052]

Note that the device illustrated in FIG. 16 can scan the substrate 1500 by securing the heads and moving the substrate 1500, and scan the substrate 1500 by securing the substrate 1500 and moving the heads.

[0053]

Each of the heads 1505a, 1505b, and 1505c of the droplet discharging means is connected to a controlling means. The heads can draw a pattern that is preliminarily programmed by controlling the controlling means by a computer. The amount of discharging is controlled by an applied pulse voltage. The timing of the drawing, for example, may be based on the marker formed over the substrate. Alternatively, the base point may be decided on the basis of the edge of the substrate. The base point is detected by an imaging means such as CCD, converted into a digital signal by an image processing means, and recognized by a computer to generate a control signal. Then, the control signal is sent to the controlling means. Of course, information on a pattern that should be formed over a substrate is stored in a storing medium. The control signal can be sent based on this information to the controlling means to control each head of the droplet discharging means individually.

[0054]

Then, a part of the conductive film pattern is selectively irradiated with laser light to be exposed (FIG. 1 (B)). A photosensitive material is preliminarily contained in a conductive film material solution to be discharged to bring about a chemical reaction due to the laser light which is emitted. As the photosensitive material, an

example of using a negative type photosensitive material leaving a portion that is reacted chemically by irradiation is described. By the laser light irradiation, a wiring having a precise pattern form, particularly, having a thin width can be obtained.

[0055]

Here, a laser beam drawing device is explained with reference to FIG. 4. A laser beam drawing device 401 comprises a personal computer (hereinafter, referred to as PC) 402 for executing various kinds of control in emitting a laser beam; a laser oscillator 403 for outputting a laser beam; a power source 404 of the laser oscillator 403; an optical system (ND filter) 405 for attenuating a laser beam; an acoustooptical modulator (AOM) 406 for modulating the intensity of a laser beam; a lens for enlarging and shrinking the cross-section of a laser beam; an optical system 407 composed of a mirror and the like for changing an optical path; a substrate moving mechanism 409 having an X stage and a Y stage; a D/A conversion portion 410 for digital-analog conversion of a control data outputted from the PC; a driver 411 for controlling the acoustooptical modulator 406 depending on analog voltage outputted from the D/A conversion portion; and a driver 412 for outputting a driving signal for driving the substrate moving mechanism 409.

[0056]

As the laser oscillator 403, the laser oscillator capable of oscillating ultraviolet light, visible light, or infrared light can be used. As the laser oscillator, an excimer laser oscillator such as KrF, ArF, KrF, XeCl, or Xe; a gas laser oscillator such as He, He-Cd, Ar, He-Ne, or HF; a solid laser oscillator using crystals such as YAG, $GdVO_4$, YVO_4, YLF, or $YalO_3$ doped with Cr, Nd, Er, Ho, Ce, Co, Ti, or Tm; or a semiconductor laser oscillator such as GaN, GaAs, GaAlAs, or InGaAsP can be used. Note that in the solid laser oscillator, a first harmonic to a fifth harmonic of a fundamental wave are preferably adopted.

[0057]

Hereinafter, a method for exposing a photosensitive material to light using a laser beam direct drawing device is explained. The photosensitive material as used herein means a conductive film material (including a photosensitive material) that is to be a conductive film pattern.

[0058]

When a substrate 408 is mounted on a substrate moving mechanism 409, the PC 402 detects the position of the marker attached to the substrate by a camera outside of the drawing. Then, the PC 402 produces movement data for moving the substrate moving mechanism 409 based on the position data of the marker that is detected and draw pattern data that is preliminarily inputted. And then, a laser beam outputted from the laser oscillator 403 is attenuated by the optical system 405, and the quantity of light is controlled to a predetermined quantity of light by the acoustooptical modulator 406 by means of the control of quantity of output light of the acoustooptical modulator 406 by the PC 402 via the driver 411. Meanwhile, a laser beam outputted from the acoustooptical modulator 406 is varied in its optical path and beam shape by the optical system 407, and condensed by a lens. Then, the beam is emitted to a photosensitive material formed over the substrate to expose the photosensitive material. At this time, movement control of the substrate moving mechanism 409 is performed in X direction and Y direction according to the movement data produced by the PC 402. As a result, a laser beam is emitted to a predetermined spot to expose a photosensitive material.

[0059]

A part of the energy of the laser light emitted to the photosensitive material is converted into heat to react a part of the photosensitive material. Therefore, a width of a pattern becomes slightly larger than that of a laser beam. Further, since laser light of a short wavelength can make it easier for beam diameter to be converted small, a laser beam of a short wavelength is preferably emitted to form a pattern having an extremely thin width.

[0060]

In addition, the form of a laser beam spot on a surface of the photosensitive material is processed to have a point like shape, a round shape, an elliptical shape, a rectangular shape, or a line form (in a strict sense, an elongated oblong shape) by an optical system. The laser beam spot form may be a round shape. However, the laser beam spot form is preferably a line form, since the line form laser spot can form a pattern having a uniform width.

[0061]

An example of the device illustrated in FIG. 4 that exposes the substrate to laser light by emitting the laser light from the substrate surface side is described. However,

a laser beam drawing device with an appropriately varied optical system or substrate moving mechanism that exposes the substrate to laser light by emitting the laser light from the reverse substrate surface side may be used.

[0062]

Here, a laser beam is selectively emitted while moving the substrate. However, the present invention is not limited thereto. A laser beam can be emitted while scanning the laser beam into X-Y axis direction. In this instance, a polygon mirror or a galvanometer mirror is preferably used as the optical system 407.

[0063]

Then, development is performed by using etchant (or developing solution) to remove excess portions, and main baking is performed to form a metal wiring 15 serving as a gate electrode or a gate wiring (FIG. 1 (C)).

[0064]

A wiring 40 extending to a terminal portion is formed as well as the metal wiring 15. Although not shown, a power line may be formed to supply current to a light-emitting element. In addition, a capacitor electrode or a capacitor wiring can be formed to form a storage capacitor if necessary.

[0065]

Note that, in the case that a positive photosensitive material is used, the portion to be removed may be irradiated with laser to yield a chemical reaction, and the portion may be dissolved by etchant.

[0066]

Alternatively, exposure by laser light irradiation may be performed after a conductive film material solution is dropped, dried at room temperature, and pre-baked.

[0067]

Then, a gate insulating film 18, a semiconductor film, and an n-type semiconductor film are sequentially deposited by a plasma CVD method or a sputtering method.

[0068]

As the gate insulating film 18, a material containing silicon oxide, silicon nitride, or silicon oxynitride as its main component obtained by a PCVD method is used. In addition, the gate insulating film 18 may be formed to be a SiOx film including an

alkyl group by discharging by a droplet discharging method using siloxane based polymer and baking.

[0069]

The semiconductor film is formed with an amorphous semiconductor film or a semiamorphous semiconductor film formed by a vapor growth method, a sputtering method, or a thermal CVD method, each of which uses a semiconductor material gas as typified by silane or germane.

[0070]

As the amorphous semiconductor film, an amorphous silicon film that is obtained by a PCVD method using SiH_4 or a mixed gas of SiH_4 and H_2 can be used. In addition, as the semiamorphous semiconductor film, a semiamorphous silicon film that is obtained by a PCVD method using a mixed gas of SiH_4 diluted with H_2 by 3 to 1000 times, a mixed gas of Si_2H_6 and GeF_4 to have a gas flow ratio of 20 ~ 40: 0.9 (Si_2H_6: GeF_4), a mixed gas of Si_2H_6 and F_2 or a mixed gas of SiH_4 and F_2 can be used. Further, the semiamorphous silicon film is preferably used since the semiamorphous silicon film can hold more crystallinity at an interface between the semiamorphous silicon film and a base.

[0071]

In addition, the crystallinity may be further improved by laser light irradiation to the semiamorphous silicon film obtained by a PCVD method using a mixed gas of SiH_4 and F_2.

[0072]

An n-type semiconductor film can be formed with an amorphous semiconductor film or a semiamorphous semiconductor film by a PCVD method using a silane gas and a phosphine gas. Although an n-type semiconductor film 20 is preferably provided since the contact resistance between the semiconductor film and an electrode (formed in the subsequent process) becomes lower, the n-type semiconductor film 20 may be provided as-needed basis.

[0073]

Then, a mask 21 is provided to obtain an island-like semiconductor film 19 and the n-type semiconductor film 20 by etching selectively the semiconductor film and the n-type semiconductor film (FIG. 1 (D)). As a method for forming the mask 21, a

droplet discharging method or a printing method (relief printing, surface printing, gravure printing, screen printing, or the like) is used. A desired mask pattern may be directly formed by a droplet discharging method or a printing method. Alternatively, a high definition microscopic resist pattern may be formed by forming sketchily a resist pattern by a droplet discharging method or a printing method, and by exposing selectively the resist pattern with use of laser light.

[0074]

By using a laser beam drawing device illustrated in FIG. 4, resist can be exposed to light. In this instance, the resist mask 21 may be formed by exposing a photosensitive material used as resist to laser light.

[0075]

Then, after removing the mask 21, a mask (not shown) is provided, and the gate insulating film is selectively etched to form a contact hole. Further, the gate insulating film is removed at an edge portion. As a way of forming the mask, resist pattern is formed by a general photolithography technique or a droplet discharging method; or resist pattern is formed by applying positive type resist over a whole surface to be exposed to laser light and developed. In an active matrix light-emitting device, a plurality of TFTs is provided per pixel to have a connecting portion to an upper layered wiring via a gate electrode and a gate insulating film.

[0076]

Then, source or drain wirings 22, 23 and a leading out electrode 17 are formed by discharging selectively a composite containing a conductive material (Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like) by a droplet discharging method. Similarly, a power line of supplying current to a light-emitting element and a connecting wiring (not shown) are also formed at a terminal portion (FIG. 1 (E)).

[0077]

Then, the n-type semiconductor film and an upper layer portion of the semiconductor film are etched using the source or drain wirings 22, 23 as masks to obtain the state illustrated in FIG. 2 (A). At this stage, a channel etch TFT having a channel formation region 24 which serves as an active layer, a source region 26, and a drain region 25, is completed.

[0078]

In addition, a protective film 27 to prevent the channel formation region 24 from being contaminated by impurities is formed (FIG. 2 (B)). As the protective film 27, a material containing silicon nitride or silicon nitride oxide as its main component formed by a sputtering method or a PCVD method is used. In this instance, an example of using the protective film is described, however, the protective film is not necessarily provided if not needed.

[0079]

Then, an interlayer insulating film 28 is selectively formed by a droplet discharging method. As the interlayer insulating film 28, a resin material such as epoxy resin, acrylic resin, phenol resin, novolac resin, acryl resin, melamine resin, or urethane resin is used. In addition, an organic material such as benzocyclobutene, parylene, flare, or polyimide having permeability; a compound material formed by polymerization of siloxane polymer and the like; a composite material containing water-soluble homopolymer and water-soluble copolymer; or the like is formed by a droplet discharging method. A method for forming the interlayer insulating film 28 is not particularly limited to the droplet discharging method. A coating method, a PCVD method, or the like can be used to form the interlayer insulating film 28 over a whole surface.

[0080]

Then, the protective film is etched using the interlayer insulating film 28 as a mask to form a convex portion (pillar) 29 made from a conductive member over a part of the source or drain wiring 22, 23. The convex portion (pillar) 29 may be stacked by repeating discharging and baking of a composite containing a conductive material (Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like).

[0081]

And then, a first electrode 30 being in contact with the convex portion (pillar) 29 is formed over the interlayer insulating film 28 (FIG. 2 (C)). Note that, similarly, a terminal electrode 41 being in contact with the wiring 40 is also formed. Here, an example of n-channel type driving TFT is described, and so the first electrode 30 serves preferably as a cathode. In the case of passing light through the first electrode 30, the first electrode 30 is formed by forming a predetermined pattern made from a composite containing indium tin oxide (ITO), indium tin oxide containing silicon oxide (ITSO),

zinc oxide (ZnO), tin oxide (SnO_2), or the like by a droplet discharging method or a printing method to be baked. Thus, the first electrode 30 and the terminal electrode 41 are formed. In addition, in the case of reflecting light by the first electrode, a predetermined pattern is formed with a composite made from metal particles as its main component, such as Ag (silver), Au (gold), Cu (copper), W (tungsten), or Al (aluminum), by a droplet discharging method to be baked. Thus, the first electrode 30 and the terminal electrode 41 are formed. As another method, the first electrode 30 may be formed by forming a transparent conductive film or a light-reflective conductive film by a sputtering method, and forming a mask pattern by a droplet discharging method, then, combining etching therewith.

[0082]

FIG. 3 illustrates an example of a top view of a pixel at the stage illustrated in FIG. 2 (C). In FIG. 3, a cross-section taken along chain line A-A' corresponds to a cross-sectional view of the right side of the pixel portion in FIG. 2 (C), and chain line B-B' corresponds to a cross-sectional view of the left side of the pixel portion in FIG. 2 (C). Note that in FIG. 3, corresponding components as of FIG. 1 to FIG. 2 are denoted by like numerals. In addition, in FIG. 3, the portion to be an edge portion of a bank 34 that is formed subsequently is indicated by a dotted line.

[0083]

Further, since an example of providing the protective film 27 is shown here, the interlayer insulating film 28 and the convex portion (pillar) 29 are formed separately. In the case that the protective film is not provided, the interlayer insulating film 28 and the convex portion (pillar) 29 can be formed by a droplet discharging method using the same device.

[0084]

Then, the bank 34 for covering the periphery of the first electrode 30 is formed. The bank 34 (also referred to as an embankment) is made from a material containing silicon, an organic material, and a compound material. Further, a porous film can also be used. The bank 34 is preferably formed by using a photosensitive material or non-photosensitive material such as acrylic or polyimide. Since the bank 34 is formed to have a shape with a side surface having a radius of curvature varying continuously, an upper thin film of the bank 34 can be formed without being disconnected, which is

preferable.

[0085]

According to the foregoing processes, a TFT substrate used for a light-emitting display panel in which a bottom gate (also referred to as reverse staggered) TFT and a first electrode are formed over the substrate 10 is completed.

[0086]

Then, a layer serving as an electroluminescent layer, that is, a layer containing an organic compound 36 is formed. The layer containing an organic compound 36 has a layered structure in which each layer is formed by a vapor deposition method or a coating method. For example, an electron transporting layer (electron injecting layer), a light-emitting layer, a hole transporting layer, and a hole injecting layer are sequentially formed over a cathode.

[0087]

The electron transporting layer contains a charge injecting-transporting substance. As a charge injecting-transporting substance having a high electron transporting property, a metal complex or the like having a quinoline skeleton or benzoquinoline skeleton such as tris(8-quinolinolate) aluminum (abbreviated Alq_3), tris(5-methyl-8-quinolinolate) aluminum (abbreviated $Almq_3$), bis(10-hydroxybenzo[h]-quinolinato) beryllium (abbreviated $BeBq_2$), and bis(2-methyl-8-quinolinolate)-4-phenylphenolato-aluminum (abbreviated BAlq) can be nominated. As a substance having a high hole transporting property, an aromatic amine based compound (that is, the one having a benzene ring-nitrogen bond) such as 4,4'-bis[N-(1-naphthyl)-N-phenyl-amino]-biphenyl (abbreviated a-NPB), 4,4'-bis[N-(3-methylphenyl)-N-phenyl-amino]-biphenyl (abbreviated TPD), 4,4',4"-tris(N,N-diphenyl-amino)-triphenyl amine (abbreviated TDATA), and 4,4',4"-tris[N-(3-methylphenyl)-N-phenyl-amino]-triphenyl amine (abbreviated MTDATA) can be nominated.

[0088]

In addition, among the charge injecting-transporting substances, as a substance especially having a high electron injecting property, a compound of an alkali metal or an alkali earth metal such as lithium fluoride (LiF), cesium fluoride (CsF), calcium fluoride (CaF_2), or the like can be used. Besides, mixture of a substance having a high electron

transportation property such as Alq_3 and alkali earth metal such as magnesium (Mg) can be used.

[0089]

In addition, a light-emitting layer is formed by using a charge injecting-transporting substance and a light-emitting material, each of which contains an organic compound or an inorganic compound. The light-emitting layer may include a layer made from one kind or a plurality kinds selected based on its molecularity from a low molecular weight organic compound, an intermediate molecular weight organic compound (an organic compound which does not have subliming property and has molecularity of 20 or less, or has a molecular chain length of 10 μm or less), and a high molecular weight organic compound, and can be combined with an inorganic compound having a elecrtron injecting-transporting property or a hole injecting transporting property.

[0090]

As a light-emitting material, various materials can be given. As a low molecular weight organic light-emitting material, 4-dicyanomethylene-2-methyl-6-(1,1,7,7-tetramethyljulolidyl-9-enyl)-4H-pyran (abbreviated DCJT), 4-dicyanomethylene-2-t-butyl-6-(1,1,7,7-tetramethyljulolidyl-9-enyl)-4H-pyran (abbreviated DPA), periflanthene, 2,5-dicyano-1,4-bis(10-metoxy-1,1,7,7-tetramethyljulolidyl-9-enyl)benzene, N,N'-dimethylquinacridone (abbreviated DMQd), coumarin 6, coumarin 545T, tris(8-quinolinolato)aluminum (abbreviated Alq_3), 9,9'-biantrile, 9,10-diphenylantracene (abbreviated DPA), 9, 10-bis(2-naphtyl)anthracene (abbreviated DNA), or the like can be used. In addition, another substance may also be used.

[0091]

A high molecular weight organic light-emitting material has higher physical strength than that of a low molecular weight organic light-emitting material and provides high element durability. An element can be comparatively readily manufactured since a light-emitting layer can be formed by coating. The structure of the light-emitting element using the high molecular weight organic light-emitting material is basically the same as that using the low molecular weight organic

light-emitting material, that is, cathode/organic light-emitting layer/anode. However, in the case that the light-emitting layer is formed by using the high molecular weight organic light-emitting material, it is difficult to form a layered structure that is formed in the case of using the low molecular weight organic light-emitting material and a two layered structure is used in many cases. Specifically, the structure is cathode/light-emitting layer/hole transporting layer/anode.

[0092]

Emission color is determined by a material for forming the light-emitting layer. Accordingly, a light-emitting element exhibiting desired emission can be formed by selecting the material for the light-emitting layer. As a high molecular weight electroluminescent material used for forming the light-emitting layer, a polyparaphenylene vinylene based material, a polyparaphenylene based material, a polythiophene based material, and a polyfluorene based material can be nominated.

[0093]

As the polyparaphenylene vinylene based material, a derivative of poly(paraphenylene vinylene) [PPV], poly(2,5-dialkoxy-1,4-phenylen vinylene) [RO-PPV], poly(2-(2'-ethyl-hexoxy)-5-methoxy-1,4-phenylene vinylene) [MEH-PPV], poly(2-dialkoxyphenyl)-1,4-phenylenevinylene) [ROPh-PPV], and the like is nominated. As the polyparaphenylene based material, a derivative of polyparaphenylene [PPP], poly(2,5-dialkoxy-1,4-phenylene) [RO-PPP], poly(2,5-dihexoxy-1,4-phenylene), and the like is nominated. As the polythiophene based material, a derivative of polythiophene [PT], poly(3-alkylthiophene) [PAT], poly(3-hexylthiophene) [PHT], poly(3-cyclohexylthiophene) [PCHT], poly(3-cyclohexyl-4-methylthiophene) [PCMHT], poly(3,4-dicyclohexylthiophene) [PDCHT], poly[3-(4-octylphenyl)-thiophene] [POPT], poly[3-(4-octylphenyl)-2,2-bithiophene] [PTOPT], and the like is nominated. As the polyfluorene based material, a derivative of polyfluorene [PF], poly(9,9-dialkylfluorene) [PDAF], poly(9,9-dioctylfluorene) [PDOF], and the like is nominated.

[0094]

An injecting property of holes from the anode can be improved by interposing a high molecular weight organic light-emitting material having a hole transporting property between the anode and a high molecular weight organic light-emitting material

having a light-emitting property. Generally, the high molecular weight organic light-emitting material having a hole transporting property dissolved in water together with an acceptor material is applied by a spin coating method. In addition, the high molecular weight organic light-emitting material having a hole transporting property is not dissolved in organic solvent, accordingly, the material can be stacked with the organic light-emitting material having a light-emitting property. As the high molecular weight organic light-emitting material having a hole transporting property, mixture of PEDOT and camphoric sulfonic acid (CSA) as an acceptor material, mixture of polyaniline [PANI] and polystyrene sulfonic acid [PSS] as an acceptor material, and the like can be nominated.

[0095]

Further, besides the singlet excited light-emitting material, a triplet excited material containing a metal complex or the like can be used for the light-emitting layer. For example, among a red emitting pixel, a green emitting pixel, and a blue emitting pixel; a red emitting pixel having comparative short half-brightness time is formed by using a triplet excited light-emitting material and the other are formed by using singlet excited light-emitting materials. The triplet excited light-emitting material has a characteristic that it requires lower power consumption to obtain the same luminance since the triplet excited light-emitting material has high luminous efficiency. That is, in the case that the triplet excited light-emitting material is used for forming the red emitting pixel, the reliability can be improved since the light-emitting element requires a small amount of current flowing therethrough. To reduce power consumption, the red emitting pixel and the green emitting pixel may be formed by using the triplet excited light-emitting material, and the blue emitting pixel may be formed by using a single excited light-emitting material. The power consumption of a green light-emitting element that has high visibility for human can be further reduced by using the triplet excited light-emitting material for forming the green light-emitting element.

[0096]

As an example for the triplet excited light-emitting material, a material using a metal complex as a dopant such as a metal complex including platinum that is the third transition element as a central metal, a metal complex including iridium as a central metal, or the like is known. The triplet excited light-emitting material is not limited to

these compounds. A compound that has the foregoing structure and that has an element belonging 8 to 10 groups in the periodic table as a central metal can be used.

[0097]

In addition, the hole transporting layer contains a charge injecting and transporting substance. As a substance having a high hole injecting property, for example, metal oxide such as molybdenum oxide (MoOx), vanadium oxide (VOx), ruthenium oxide (RuOx), tungsten oxide (WOx), manganese oxide (MnOx), or the like can be nominated. Besides, a phthalocyanine based compound such as phthalocyanine (abbreviated H_2Pc) or copper phthalocyanine (CuPc) can be nominated.

[0098]

Before forming the layer containing an organic compound 36, plasma treatment in oxygen atmosphere or heat treatment in vacuum atmosphere is preferably performed. In the case of using a vapor deposition method, an organic compound is vaporized by resistance heating in advance, and scattered toward the direction of a substrate by opening a shutter in depositing. The vaporized organic compound is scattered upward and deposited over a substrate through an opening portion provided for a metal mask. In addition, to realize full color display, alignment of a mask may be performed per emission color (R, G, and B).

[0099]

A light-emitting layer may have the structure in which light-emitting layers having different emission wavelength bands are respectively provided for each pixel for realizing full color display. Typically, light-emitting layers corresponding to colors of R (red), G (green), and B (blue) are formed. In this instance, color purity can be improved and a pixel portion can be prevented from being a mirror surface (reflection) by providing a filter (colored layer) transmitting light in its emission wavelength region at the light emission side of the pixel. By providing the filter (colored layer), a circularly-polarized light plate or the like that is conventionally required becomes not required, further, loss of light emitted from the light-emitting layer can be eliminated. Moreover, color changes occurring in the case of viewing obliquely the pixel portion (display screen) can be further reduced.

[0100]

Alternatively, full color display can be realized by using a material exhibiting a

monochromatic emission as the layer containing an organic compound 36, and combining a color filter or color conversion layer without separate coloring. For example, in the case that an electroluminescent layer exhibiting white or orange emission is formed, full color display can be realized by providing separately a color filter, or a color filter, a color conversion layer, or a combination of the color filter and the color conversion layer at the light emission side of the pixel. The color filter or the color conversion layer may be formed, for example, over a second substrate (sealing substrate) and pasted onto another substrate. Further, as mentioned above, all of the material exhibiting monochromatic emission, the color filter, and the color conversion layer can be formed by a droplet discharging method.

[0101]

To form a light-emitting layer that exhibits white emission, for example, Alq_3, Alq_3 partly doped with Nile red which is a red emitting pigment, Alq_3, p-EtTAZ, and TPD (aromatic diamine) are stacked sequentially by a vapor deposition method. In the case that EL is formed by a coating method such as spin coating, the material is preferably baked by vacuum heating after being applied. For example, poly(ethylene dioxythiophene)/poly(styrene sulfonate) solution (PEDOT/PSS) that acts as the hole injecting layer may be applied over a whole surface and baked, and polyvinylcarbazole (PVK) solution doped with pigments (1,1,4,4-tetraphenyl-1,3-butadiene (TPB), 4-dicyanomethylene-2-methyl-6-(p-dimethylamino-styryl)-4H-pyran (DCM1), Nile red, coumarin 6, or the like) that acts as the light-emitting layer may be applied over a whole surface and baked.

[0102]

The light-emitting layer may also be formed by a single layer. In polyvinylcarbazole (PVK) with the hole transporting property, a 1,3,4-oxadiazole derivative (PBD) with the electron transporting property may be dispersed. Further, white emission can be obtained by dispersing PBD of 30 wt% as the electron transporting agent and dispersing an appropriate amount of four kinds of pigments (TPB, coumarin 6, DCM1, and Nile red).

[0103]

Above mentioned substances for forming the layer containing an organic compound are just examples. The light-emitting element can formed by appropriately

stacking each functional layer such as a hole injecting-transporting layer, a hole transporting layer, an electron injecting-transporting layer, an electron transporting layer, a light-emitting layer, an electron blocking layer, and a hole blocking layer. In addition, a mixed layer or mixed junction of the foregoing layers may be formed. The layer structure of the light-emitting layer is capable of being varied. Therefore, instead of providing a specified electron injecting region or light emitting region, modifications such as providing an electrode in order to be used for the electron injecting region or the light emitting region, or providing a dispersed light-emitting material can be allowed unless otherwise such modifications depart from the scope of the present invention.

[0104]

Needless to say, monochromatic emission display can be performed. For example, an area color type light-emitting display device can be formed by utilizing monochromatic emission. A passive matrix type display portion is suitable for the area color type and can display mainly texts or symbols.

[0105]

Then, a second electrode 37 is formed. The second electrode 37 serving as an anode of the light-emitting element is formed by using a transparent conductive film, which can transmit a light, for example, by using, in addition to ITO and ITSO, mixture of indium oxide with zinc oxide (ZnO) of 2 ~ 20 %. The light-emitting element has the structure in which the layer containing an organic compound 36 is interposed between the first electrode and the second electrode. Note that a material for the first electrode and the second electrode should be selected in consideration of a work function. Either the first electrode or the second electrode is capable of being an anode or a cathode according to a pixel structure.

[0106]

The light-emitting element formed by using the foregoing materials emits light under forward bias. A pixel of a display device formed by using the light-emitting element can drive by either a simple matrix mode or an active matrix mode. At any rate, each pixel emits light by applying forward bias at a specified timing. Further, the pixels are in non-emission state for a certain period. The reliability of the light-emitting element can be improved by applying reverse bias in the non-emission state. The light-emitting element may be have deterioration of lowering emission

intensity under a regular driving condition or may be in a deterioration mode of lowering apparently luminance due to the expansion of a non-emission region within the pixel. The deterioration progression can be delayed by AC driving to apply forward bias and reverse bias, which leads to the improvement of the reliability of the light-emitting device.

[0107]

In addition, an auxiliary electrode may be provided over a region of the second electrode that does not serve as a light-emitting region to lower the resistance of the second electrode 37.

[0108]

In addition, a protective layer for protecting the second electrode 37 may be formed. For example, a protective film can be formed by forming a silicon nitride film by using a discotic target made from silicon in a deposition chamber of nitrogen atmosphere or atmosphere including nitrogen and argon. Further, a thin film containing carbon as its main component (a DLC film, a CN film, or an amorphous carbon film) can be formed as the protective film and other deposition chamber using a CVD method may be provided. A diamond like carbon film (also referred to as a DLC film) can be formed by a plasma CVD method (typically, an RF plasma CVD method, a micro wave CVD method, an electron cyclotron resonance (ECR) CVD method, a heat filament CVD method, or the like), a combustion-flame method, a sputtering method, an ion beam deposition method, a laser deposition method, or the like. Hydrogen gas and hydrocarbon gas (e.g., CH_4, C_2H_2, C_6H_6, or the like) are used as a reaction gas for deposition. The reaction gases are ionized by glow discharging, and the ions are made accelerated to collide to a cathode applied with negative self-bias, then, the DLC film is deposited. Further, the CN film may be formed by using C_2H_4 gas and N_2 gas as reaction gas. In addition, the DLC film and the CN film are insulating films transparent or semitransparent to visible light. The term "transparent to visible light" means having a transmittance of 80 ~ 100 % for visible light. The term "semitransparent to visible light" means having a transmittance of 50 ~ 80 % for visible light. Note that the protective film is not always necessarily provided if not needed.

[0109]

Then, a sealing substrate 35 is pasted by sealant (not shown) to seal the

light-emitting element. Note that the space surrounded by the sealant is filled with transparent filler 38. The filler 38 is not especially limited as long as it has a light-transmitting property. Typically, ultraviolet curing or thermal curing epoxy resin may be used. Here, high heat-resistant UV epoxy resin (manufactured by Electrolite Cooperation : 2500 Clear) having refractivity of 1.50, viscosity of 500 cps, shore D hardness of 90, tensil intensity of 3000 psi, Tg point of 150 °C, volume resistance of 1×10^{15} Ωcm, and withstand voltage of 450 V/mil is used. Further, filling a space between a pair of substrates with the filler 38 can improve the whole transmittance.

[0110]

Lastly, an FPC 46 is pasted onto the terminal electrode 41 by an anisotropic conductive film 45 in accordance with the known method (FIG. 2(D)).

[0111]

According to the foregoing processes, an active matrix light-emitting device can be manufactured.

[0112]

FIG. 10 illustrates a top view for showing an example of an EL display panel structure. FIG. 10 illustrates a structure of a light-emitting display panel that controls a signal to be inputted to a scanning line and a signal line by an external driver circuit. A pixel portion 2701 composed of pixels 2702 arranged in a matrix configuration over a substrate 2700 having an insulating surface, a scanning line side input terminal 2703, and a signal line side input terminal 2704 are formed. The number of pixels may be set according to various specifications, for example, $1024 \times 768 \times 3$ (RGB) for XGA, $1600 \times 1200 \times 3$ (RGB) for UXGA, or $1920 \times 1080 \times 3$ (RGB) in the case of corresponding to full spec high vision.

[0113]

The pixels 2702 are arranged in a matrix configuration by crossing scanning lines extending from the scanning line side input terminal 2703 and signal lines extending from the signal line side input terminal 2704. Each of the pixels 2702 is provided with a switching element and a pixel electrode that connects to the switching element. A typical example of the switching element is a TFT. Each of the pixels can be independently controlled by signals inputted from outside by connecting the scanning line to a gate electrode side of the TFT and connecting a source side or a drain

side to the signal lines.

[0114]

Note that, in the case of forming the first electrode by using a transparent material and forming the second electrode by using a metal material, a structure of emitting and extracting light through the substrate 10, that is, a bottom emission type is formed. Alternatively, in the case of forming the first electrode by using a metal material and forming the second electrode by using a transparent material, a structure of emitting and extracting light through the sealing substrate 35, that is, a top emission type is formed. Further alternatively, in the case of forming the first and second electrodes by using transparent materials, a structure of emitting and extracting light through both of the substrate 10 and the sealing substrate 35 is formed. The present invention may appropriately adopt any one of the foregoing structures.

[0115]

As mentioned above, a microscopic pattern can be formed by exposing the conductive film pattern using a droplet discharging method to laser light and developing in this embodiment. By forming various patterns directly over the substrate by a droplet discharging method, an EL display panel can be readily manufactured even if a fifth generation and later glass substrate having a side of over 1000 mm is used.

[0116]

In addition, this embodiment explains a process that does not perform spin coating and that does not perform a light exposure process using a photo mask as much as possible. However, the present invention is not particularly limited thereto, and a part of the patterning can be performed by a light exposure process using a photo mask.

[0117]

(Embodiment 2)

In Embodiment 1, an example of exposing a gate wiring by a laser beam drawing device is described. In this embodiment, a process example of using a laser beam drawing device for forming a source wiring or a drain wiring is explained with reference to FIG. 5.

[0118]

Note that the process differs only partially from that explained Embodiment 1, and so the description for the same process will be omitted for simplification.

[0119]

First, similarly to Embodiment 1, a process up to a patterning process of a semiconductor film is performed. Then, a conductive film pattern 220 is formed by a droplet discharging method (FIG. 5 (A)). A positive type photosensitive material is contained into the conductive film pattern 220.

[0120]

Then, the conductive film pattern 220 is exposed to laser light selectively by using the device illustrated in FIG. 4 (FIG. 5 (B)). A portion 221 that is irradiated with the laser light brings about chemical reactions.

[0121]

Then, the portion 221 that is irradiated with laser light is removed by developing to form source or drain wirings 222, 223 (FIG. 5 (C)).

[0122]

Since the space between the source or drain wirings 222, 223 formed in this manner is determined by laser light irradiation, a practitioner can freely set the space. Setting freely the space between the source or drain wirings 222, 223 is useful since the space determines the length (L) of a channel formation region.

[0123]

Next, the state illustrated in FIG. 5 (D) is obtained by etching an n-type semiconductor film and an upper layer portion of the semiconductor film using the source or drain wirings 222, 223 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 224 that serves as an active layer, a source region 226, and a drain region 225, is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description will be omitted.

[0124]

In the case of forming the source wiring or the drain wiring by using a droplet discharging method, the space therebetween should be secured to some extent in consideration of a margin for dripping or the like. Therefore, the length (L) of the channel formation region was difficult to be reduced. When exposure can be performed using the laser light as explained in this embodiment, the length (L) of the channel formation region can be shortened, for example, 10 μm or less.

[0125]

In addition, this embodiment can be freely combined with Embodiment 1.

[0126]

(Embodiment 3)

In addition, FIG. 6 illustrates an example of other process. In FIG. 6, an example of using a planarizing film as a gate insulating film 260 is illustrated. Other portions are the same as those explained in Embodiment 2.

[0127]

Here, after forming a gate electrode, the gate insulating film 260 having a plane surface is formed by a sputtering method, a planarizing treatment of a film obtained by a CVD method, or a coating method. Note that the planarizing treatment is typified by CMP treatment or the like.

[0128]

In the case of manufacturing a light-emitting display device having a large area screen, a gate wiring having low resistance may be preferably formed to have a thick thickness, for example, of 1 μm ~ 5 μm. When a cross-sectional area is increased by increasing the thickness of a wiring, difference in level between the surface of the substrate and the surface of the thick film wiring is produced, which leads to coverage deterioration. The plane gate insulating film 260 is useful in the case of increasing the thickness of the gate wiring as described above.

[0129]

Generally, the substrate surface provided with a metal wiring has a structure with a protrusion by the thickness of the metal wiring. In this embodiment, the substrate surface is plane because of the plane gate insulating film 260. Accordingly, coverage deterioration or the like hardly occurs even if the thickness of a semiconductor film is reduced.

[0130]

Then, similarly to Embodiment 1, a semiconductor film and an n-type semiconductor film are sequentially formed. Then, a mask is provided to etch selectively the semiconductor film and the n-type semiconductor film. Accordingly, island like semiconductor film and n-type semiconductor film can be obtained.

[0131]

Then, similarly to Embodiment 2, a conductive film pattern 250 is formed by a

droplet discharging method (FIG. 6 (A)).

[0132]

Then, the conductive film pattern 250 is selectively exposed to laser light by using the device illustrated in FIG. 4 (FIG. 6 (B)).

[0133]

Then, a portion 251 that is irradiated with laser light is removed by developing to form source or drain wirings 252, 253 (FIG. 6 (C)).

[0134]

Next, the state illustrated in FIG. 6 (D) is obtained by etching the n-type semiconductor film and an upper layer portion of the semiconductor film using the source or drain wirings 252,253 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 254 that serves as an active layer, a source region 256, and a drain region 255 is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description thereof will be omitted.

[0135]

In addition, this embodiment can be freely combined with Embodiment 1 or Embodiment 2.

[0136]

(Embodiment 4)

FIG. 7 illustrates an example of a process of forming a source wiring or a drain wiring using a gate electrode as a mask in a self-aligning manner by light exposure of a reverse-surface.

[0137]

First, a base insulating film 301 is formed over a substrate. As the base insulating film 301, a base film formed with an insulating film such as a silicon oxide film, a silicon nitride film, or a silicon oxynitride film is formed. Note that the base insulating film may not be formed when it is not required.

[0138]

Then, a conductive film having a thickness of 100 ~ 600 nm is formed by a sputtering method over the base insulating film 301. Note that the conductive film may be formed of an element selected from Ta, W, Ti, Mo, Al, and Cu; a single layer

made from an alloy material or a compound material containing the foregoing elements as its main component, or a laminated layer of the foregoing single layers. Alternatively, a semiconductor film as typified by a polycrystalline silicon film doped with an impurity element such as phosphorus may be used.

[0139]

Then, a resist mask is formed by using a photo mask and etching is performed by a dry etching method or a wet etching method. The conductive film is etched by the etching process to obtain a gate electrode 302 as illustrated in FIG. 7 (A).

[0140]

Next, similarly to Embodiment 1, a gate insulating film, a semiconductor film, and an n-type semiconductor film are sequentially deposited by a plasma CVD method or a sputtering method. Then, a mask is provided to selectively etch the semiconductor film and the n-type semiconductor film. Accordingly, island like semiconductor film and n-type semiconductor film are obtained.

[0141]

Then, similarly to Embodiment 2, a conductive film pattern 320 is formed by a droplet discharging method (FIG. 7 (A)). A negative type photosensitive material is contained into the conductive film pattern 320.

[0142]

Then, the reverse surface is exposed to laser light in a self-aligning manner by using a laser beam drawing device (FIG. 7 (B)). The portion irradiated with laser light in the conductive film pattern brings about chemical reactions. Note that a substrate that has a light transmitting property is used as the substrate. Laser light having a wavelength that passes through the substrate is selected. In addition, laser light can be emitted to the semiconductor film or the n-type semiconductor film depending on the wavelength of the laser light, and laser annealing can be performed.

[0143]

And then, developing is performed, and a portion that is not irradiated with the laser light is removed to form source or drain wirings 322, 323 (FIG. 7 (C)).

[0144]

The space between the source or drain wirings 322, 323 formed as described above is determined by the width of the gate electrode.

[0145]

Then, the state illustrated in FIG. 7 (D) is obtained by etching the n-type semiconductor film and an upper layer portion of the semiconductor film using the source or drain wirings 322, 323 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 324 that serves as an active layer, a source region 326, and a drain region 325 is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description thereof will be omitted.

[0146]

Since a channel formation region of a TFT is formed in a self-aligning manner according to the present invention, patterning difference is not produced and variation of each TFT can be reduced. According to the present invention, a manufacturing process can be simplified.

[0147]

In addition, this embodiment can be freely combined with Embodiment 1, Embodiment 2, or Embodiment 3.

[0148]

(Embodiment 5)

A method for manufacturing an active matrix light-emitting display device having a channel stop TFT as a switching element is explained in this embodiment.

[0149]

In addition, as illustrated in FIG. 8, a base film 811 is formed over a substrate 810 as in the case of Embodiment 1 as described above. As the base film 811, TiO_2 that is a photocatalyst substance is entirely formed.

[0150]

Then, light having a wavelength that causes photocatalyst action is emitted to the desired region, that is, TiO_2 at the both edges of a region provided with a wiring in this embodiment, and an irradiated region is formed. Laser light can be used as the light having a wavelength that causes photocatalyst action. The light is selectively emitted to a desired region by using the device illustrated in FIG. 4. Accordingly, the irradiated region exhibits an oil-shedding property.

[0151]

A conductive film serving as a gate electrode 815 is formed by dropping a dot formed by mixing a conductor into solvent from an upper portion of a non irradiated region or to a non irradiated region by an ink jetting method. Simultaneously, a terminal electrode 840 is formed at a terminal portion.

[0152]

Then, a gate insulating film 818 is formed to cover the gate electrode. Thereafter, a semiconductor film is formed by plasma CVD or the like. And then, in order to form a channel protective film 827, an insulating film is formed by, for example, a plasma CVD method to be patterned at a desired region to have a desired form. In this instance, the channel protective film 827 can be formed by exposing the reverse surface of the substrate to light using the gate electrode as a mask. Further, the channel protective film may be formed by dropping polyimide, polyvinyl alcohol, or the like by an ink jetting method. As a result, an exposure process can be eliminated.

[0153]

Thereafter, a semiconductor film having one conductivity type, for example, an n-type semiconductor film is formed by a plasma CVD method or the like.

[0154]

Then, a mask made from polyimide is formed by an ink jetting method over the n-type semiconductor film. A semiconductor film 824 and the semiconductor film having n-type conductivity are patterned by using the mask. Thereafter, cleaning is performed to remove the mask.

[0155]

Next, wirings 823, 822 are formed. Then, the wirings 823, 822 can be formed by an ink jetting method. The wirings 823, 822 serve as so-called a source wiring or a drain wiring.

[0156]

Then, an interlayer insulating film 828 is formed. Then, a contact hole reaching the wiring 824 is formed in the interlayer insulating film. An electrode 830 is formed in the contact hole.

[0157]

Then, an electrode 829 connecting electrically to the wiring 824 via the electrode 830 is formed. Simultaneously, an electrode 841 is formed at the terminal

portion. The electrodes 829, 841 can be formed by an ink jetting method. The electrode 829 serves as an anode or a cathode of a light-emitting element in a light-emitting display device. As the electrode 829, a dot formed by mixing a conductor into water type solvent can be used. In particular, a transparent conductive film can be formed by using especially a transparent conductor.

[0158]

At this stage, a TFT substrate for a light-emitting panel as illustrated in FIG. 8 provided with a channel stop TFT and a first electrode is completed. The subsequent processes are the same as those explained in Embodiment 1, and the detailed description thereof will be omitted.

[0159]

In this embodiment, the wiring or the electrode that can be obtained by an ink jetting method can also be formed, as explained in Embodiment 1, by discharging a conductive film material solution containing a photosensitive material to be exposed to laser light. Further, the resist mask can also be formed by exposure to laser light.

[0160]

In addition, this embodiment can be freely combined with any one of Embodiments 1 to 4.

[0161]

(Embodiment 6)

In this embodiment, a method for manufacturing an active matrix light-emitting display device having a staggered TFT that is manufactured by a droplet discharging method as a switching element is explained.

[0162]

First, a base film 911 for improving adhesiveness with a material layer that is formed later by a droplet discharging method is formed over a substrate 910.

[0163]

Next, a source wiring layer and a drain wiring layer 923, 924 are formed by a droplet discharging method over the base film 911.

[0164]

In addition, a terminal electrode 940 is formed at a terminal portion. As a conductive material for forming the foregoing layers, a composite made from metal

particles as its main component, such as Ag (silver), Au (gold), Cu (copper), W (tungsten), or Al (aluminum), can be used. Since the source and drain wiring layers are preferably reduced in its resistance, any one of materials of gold, silver, and copper dissolved or dispersed into solvent is preferably used in consideration of specific resistance value. More preferably, silver or copper having low resistance is used. As the solvent, esters such as butyl acetate, alcohols such as isopropyl alcohol, organic solvent such as acetone, or the like can be used. The surface tension and the viscosity are appropriately controlled by adjusting the concentration of the solvent or adding surface-active agent or the like.

[0165]

Then, after an n-type semiconductor layer is formed over a whole surface, the n-type semiconductor layer between the source wiring layer and the drain wiring layer 923, 924 is removed by etching.

[0166]

Next, a semiconductor film is formed over a whole surface. The semiconductor film is formed with an amorphous semiconductor film or a semiamorphous semiconductor film formed by a vapor growth method or a sputtering method using a semiconductor material gas as typified by silane or germane.

[0167]

Then, a mask is formed by a droplet discharging method. Then, the semiconductor film and the n-type semiconductor layer are patterned to form a semiconductor layer 927 and n-type semiconductor layers 925, 926 as illustrated in FIG. 9. The semiconductor layer 927 is formed to extend over both the source wiring layer and the drain wiring layer 923, 924. The n-type semiconductor layers 925, 926 are interposed between the source wiring layer and the drain wiring layer 923, 924, and the semiconductor layer 927.

[0168]

Then, a gate insulating film is formed with a single layer or a laminated layer structure by a plasma CVD method or a sputtering method. As the most preferable mode, the gate insulating film is formed by using a stack of three layers; that is, an insulating layer made from silicon nitride, an insulting layer made from silicon oxide, and an insulating layer made from silicon nitride.

[0169]

Next, a mask is formed by a droplet discharging method to pattern the gate insulating layer 918.

[0170]

Then, a gate wiring 915 is formed by a droplet discharging method. As a conductive material for forming the gate wiring 915, a composite containing metal particles of Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like as its main component can be used. The gate wiring 915 is extended to the terminal portion to be in contact with the terminal electrode 940 of the corresponding terminal portion.

[0171]

Then, a plane interlayer insulating film 928 is formed by a coating method. In addition, the interlayer insulating film is not limited to be formed by a coating method and can be formed by using an inorganic insulating film such as a silicon oxide film formed by a vapor growth method or a sputtering method. Alternatively, a silicon nitride film may be formed by a PCVD method or a sputtering method as a protective film, and then a plane insulating film may be stacked by a coating method.

[0172]

Then, a contact hole reaching the wiring 924 is formed in the interlayer insulating film. An electrode 930 is formed in the contact hole.

[0173]

Then, an electrode 929 connecting electrically to the wiring 924 via the electrode 930 is formed. Simultaneously, an electrode 941 is formed at the terminal portion. The electrodes 929, 941 can be formed by an ink jetting method. The electrode 929 serves as an anode or a cathode of a light-emitting element in a light-emitting display device. As the electrode 929, a dot formed by mixing a conductor into water type solvent can be used. A transparent conductive film can be formed by using especially a transparent conductor.

[0174]

At this stage, a TFT substrate for a light-emitting panel as illustrated in FIG. 9 provided with a top gate (staggered) TFT and a first electrode is completed. The subsequent processes are the same as those explained in Embodiment 1, and the detailed

description thereof will be omitted.

[0175]

In this embodiment, the wiring or the electrode that is obtained by an ink jetting method can also be formed, as explained in Embodiment 1, by discharging a conductive film material solution containing a photosensitive material to be exposed to laser light. Further, the resist mask can also be formed by exposure to laser light.

[0176]

In addition, this embodiment can be freely combined with any one of Embodiments 1 to 4.

[0177]

The present invention composed of the foregoing aspects is described in more detail using the following examples.

[Example 1]

[0178]

An example of mounting a driver circuit for driving an EL display panel that is manufactured according to the best mode is explained in this example.

[0179]

First, a display device adopting COG technique is explained with reference to FIG. 11. A pixel portion 3701 for displaying information such as texts or images, and a driver circuit 3702 at a scanning side are provided over a substrate 3700. A substrate provided with a plurality of driver circuits is divided into a rectangular shape. The divided driver circuits (hereinafter, driver IC) 3705a, 3705b are mounted over the substrate 3700. FIG. 11 shows a plurality of the driver ICs 3705 and an embodiment of mounting a tape 3704 on tip of the driver ICs 3705. Alternatively, the substrate is divided to have the same sizes as that of a length of the signal line side of the pixel portion, and a tape may be mounted on a tip of the driver IC which is a single driver IC.

[0180]

Further, TAB technique may be used. In this instance, a plurality of tapes is pasted and a driver IC is mounted on the tapes. As is the case with COG technique, a single driver IC may be mounted to a single tape. In this instance, a piece of metal or the like for securing the driver IC is preferably pasted to the driver IC in consideration of intensity.

[0181]

A plurality of these driver ICs to be mounted on the EL display panel is preferably formed over a rectangular substrate having a side of from 300 mm to 1000 mm or more from a viewpoint of improving productivity.

[0182]

That is, a plurality of circuit patterns respectively having a unit composed of a driver circuit portion and an input output terminal is formed over a substrate and finally divided to be taken out. The driver IC may be formed to be a rectangular shape having a longer side of 15 ~ 80 mm and a short side of 1 ~ 6 mm, or to have a length that corresponds to one side of a pixel region, or a length of adding one side of the pixel portion to one side of each driver circuit in consideration of a length of a side of the pixel portion or a pixel pitch.

[0183]

The advantage of an outside dimension of a driver IC over an IC chip is a length of a longer side. The number of driver ICs having a longer side of 15 ~ 80 mm that is required to be mounted on a pixel portion is less than that of an IC chip, which leads to improvement in manufacturing yields. In addition, in the case of forming a driver IC over a glass substrate, the productivity is not deteriorated since the driver IC is not limited by the substrate shape used as a maternal substrate. This is a great advantage over the case where an IC chip is taken out from a circular silicon wafer.

[0184]

In FIG. 11, the driver ICs 3705a and 3705b provided with driver circuits are mounted on the outside region of the pixel region 3701. These driver ICs 3705a and 3705b are driver circuits at the side of a signal line. To form a pixel region corresponding to RGB full color, the number of signal lines of 3072 is required in an XGA class, whereas the number of signal lines of 4800 is required in an UXGA class. Signal lines composed of the number of signal lines described above are divided into several blocks at the edge of the pixel region 2401 to form lead lines and gathered along with the pitch of an output terminal of the driver ICs 3705a and 3705b.

[0185]

The driver IC is preferably formed by using a crystalline semiconductor formed over a substrate, and the crystalline semiconductor is preferably formed by laser light irradiation of continuous emission. Therefore, a solid laser or a gas laser of continuous

emission is used as an oscillator for producing the laser light. In the case of using a laser of continuous emission, a transistor with a few crystal defects can be manufactured by using a polycrystalline semiconductor layer having a large grain size. In addition, high speed driving is possible since mobility or response speed is favorable, and so operating frequency can be more improved than that of the conventional element, moreover, high reliability can be obtained since variations of characteristics are less. In order to further improve the operating frequency, the channel length direction of the transistor is preferably conformed to the scanning direction of the laser light. This is due to the fact that the highest mobility can be obtained when the channel length direction of the transistor and the substrate scanning direction of the laser light are almost in parallel with each other (preferably –30 ° ~ 30 °) in a process of laser crystallization using a continuous emission laser. Further, "channel length direction" refers to a direction of flowing current, that is, a direction of moving charges in a channel formation region. The transistor manufactured in this way has an active layer composed of a polycrystalline semiconductor layer in which crystal grains extend in the channel direction, which means that a crystal grain boundary is formed almost along with the channel direction.

[0186]

To perform laser crystallization, laser light is preferably narrow down drastically to have a beam spot width of approximately 1 ~ 3 mm that is the same as the width of a shorter side of a driver IC. Further, to secure sufficient and efficient energy density for the irradiated object, the irradiation region of laser light is preferably a linear shape. Note that the term "linear shape" does not refer to line in a strict sense, but an oblong shape or prolate ellipsoid shape with a high aspect ratio. For example, it means an oblong shape or prolate ellipsoid shape having a large aspect ratio such as 2 or more (preferably 10 to 10000). A method for manufacturing a display device with improved productivity can be provided by forming the beam spot width of laser light to have the same length as a shorter side of a driver IC.

[0187]

FIG. 11 illustrated an embodiment of forming integrally a scanning line driver circuit with a pixel portion, and mounting a driver IC as a signal line driver circuit. However, the present invention is not limited to the embodiment, and the driver IC may

be mounted as both of a scanning line driver circuit and a signal line driver circuit. In this instance, the specifications of the driver ICs used at a scanning line and a signal line may be different from each other.

[0188]

In the pixel region 3701, signal lines and scanning lines are crossed with each other to from a matrix configuration, and transistors are provided corresponding to the crossing portions. According to the present invention, there is a feature that, as a transistor provided for the pixel region 3701, a TFT having a channel portion of an amorphous semiconductor or a semiamorphous semiconductor is used. The amorphous semiconductor is formed by a method such as a plasma CVD method, a sputtering method, or the like. The semiamorphous semiconductor can be formed at temperature of 300 °C or less by a plasma CVD method. For example, the semiamorphous semiconductor has a feature of being formed to have a thickness required to form a transistor in a small amount of time even if a non alkali glass substrate having outside dimension of 550 × 650 mm is used. Such manufacturing technique is effective to manufacture a large screen display device. By forming the channel formation region by using SAS, the semiamorphous TFT can obtain electron field effect mobility of 2 ~ 10 $cm^2/Vsec$. Accordingly, the TFT can be used as a switching element of a pixel or an element for composing a driver circuit at the side of a scanning line. Therefore, an EL display panel that realizes system on panel can be manufactured.

[0189]

FIG. 11 illustrates a display device on the premise that the scanning line driver circuit is also integrally formed over the substrate by using a TFT that is formed by a semiconductor layer made from SAS. In the case of using a TFT having a semiconductor layer made from AS, both of the scanning line driver circuit and the signal line driver circuit are mounted for the driver IC.

[0190]

In this instance, the specifications of the driver ICs used at a scanning line and a signal line are preferably different from each other. The operating frequency is 100 kHz or less and high speed operation is comparatively not required despite the fact that the transistor composing the driver IC at the scanning line side is required to have, for

example, withstand voltage of approximately 30 V. Therefore, the channel length (L) of a transistor composing a driver at the scanning line side is preferably set sufficiently large. On the other hand, although withstand voltage of approximately 12 V is sufficient for the transistor of a driver IC at the signal line side, it is required to operate at high speed since the operating frequency is approximately 65 MHz at 3 V. Accordingly, the channel length and the like of the transistor composing a driver are preferably set by a micron rule.

[0191]

A method for mounting a driver IC is not especially limited, and a known COG method, a wire bonding method, or a TAB method can be used.

[0192]

By forming the driver IC to have the same thickness as that of an opposing substrate, the height of them becomes almost the same, which leads to reduction of the thickness of the display device. By manufacturing the substrates by using the same materials, heat stress does not occur even if variation in temperature arises in the display device and the characteristics of a circuit formed with a TFT are not damaged. Besides, the number of driver ICs mounted on one pixel region can be reduced by mounting a driver circuit with a drive IC that is longer than an IC chip.

[0193]

As noted above, a driver circuit can be installed in an EL display panel.

[0194]

In addition, this example can be freely combined with any one of Embodiments 1 to 6.

[Example 2]

[0195]

In this example, a light-emitting device having a thin film transistor is explained with reference to FIG. 12.

[0196]

As illustrated in FIG. 12 (A), a top gate n-channel TFT using a semiamorphous silicon film as an active layer is provided for a driver circuit portion 1310 and a pixel portion 1311.

[0197]

A method for manufacturing the top gate TFT is explained in Embodiment 6,

and detailed description thereof is here omitted.

[0198]

In this example, an n-channel TFT connected to a light-emitting element formed in the pixel portion 1311 is denoted as a drive TFT 1301. An insulating film 1302 referred to as a bank or partition is formed to cover the edge portion of an electrode (referred to as a first electrode) of the drive TFT 1301. The insulating film 1302 may be made from an inorganic material (silicon oxide, silicon nitride, silicon oxynitride, and the like), a photosensitive or nonphotosensitive organic material (polyimide, acrylic, polyamide, polyimideamide, resist, or benzocyclobutene), so-called siloxane that is a material which has a skeleton formed by the bond of silicon (Si) and oxygen (O), and which includes at least hydrogen as a substituent, or at least one of fluoride, alkyl group, and aromatic hydrocarbon as the substituent, or a layered structure of the foregoing materials. As the organic material, a positive type photosensitive organic resin or a negative type photosensitive organic resin can be used.

[0199]

Over the first electrode, an opening portion is formed in the insulating film 1302. An electroluminescent layer 1303 is provided in the opening portion, and a second electrode 1304 of a light-emitting element is formed to cover the electroluminescent layer and the insulating film 1302.

[0200]

As for the kinds of molecular exciton from the electroluminescent layer, the singlet excited state and the triplet excited state are possible. Since the ground state is generally a singlet state, light emission from the singlet state is referred to as fluorescence and light emission from the triplet state is referred to as phosphorescence. Light emission from the electroluminescent layer is possible from either of the excited states. Further, fluorescence and phosphorescence may be combined and can be selected by emission characteristics (luminance, lifetime, and the like) of each of RGB.

[0201]

The electroluminescent layer 1303 is formed by stacking, from the first electrode side, HIL (hole injecting layer), HTL (hole transporting layer), EML (light-emitting layer), ETL (electron transporting layer), and EIL (electron injecting layer), sequentially. Note that the electroluminescent layer may be formed to have a

single layer structure or a mix structure besides the layered structure.

[0202]

In addition, in the case of forming the electroluminescent layer 1303 to realize a full color display, materials which exhibit red (R), blue (B), and green (G), may each be selectively deposited by a vapor deposition method using an evaporation mask; an ink jetting method, or the like.

[0203]

Specifically, CuPc or PEDOT is used for the HTL; a-NPD is used for the HTL; BCP or Alq_3 is used for the ETL: and BCP: Li or CaF_2 is used for the EIL. In addition, for example, Alq_3 doped with dopant corresponding to each emission color of R, G, and B (DCM or the like is used in the case of R, and DMQD or the like is used in the case of G) may be used for the EML. Note that the materials for the electroluminescent layer are not limited to the foregoing materials used for a layered structure. For example, instead of using CuPc or PEDOT, oxides such as molybdenum oxide (MoOx: x= 2 ~ 3), α-NPD, and rubrene can be deposited by co-evaporation to improve a hole injecting property. As such materials, an organic material (including a low molecular material or a high molecular material) or a composite material of organic and inorganic materials can be used.

[0204]

Full color display can be realized by providing separately a color filter, or a color filter and a color conversion layer in the case of forming an electroluminescent layer exhibiting white emission. The color filter or the color conversion layer may be provided over, for example, a second substrate (sealing substrate) to be pasted together. The color filter or the color conversion layer can be formed by an ink jetting method. Needless to say, a monochromatic light-emitting device can be manufactured by forming an electroluminescent layer exhibiting emission color other than white. Further, an area color display device capable of monochromatic display can be manufactured.

[0205]

In addition, materials for the first electrode and the second electrode 1304 are required to be selected in consideration of a work function. Note that the first electrode and the second electrode may be either of an anode or a cathode by a pixel

constitution. In this example, since the polarity of a drive TFT is an n-channel type, the first electrode serves preferably as a cathode and the second electrode serves preferably as an anode. Further, in the case that the polarity of the drive TFT is a p-channel type, the first electrode serves preferably as an anode and the second electrode serves preferably as a cathode.

[0206]

In this example, since the polarity of a drive TFT is an n-channel type, the structure composed of the first electrode serving as a cathode, EIL (electron injecting layer), ETL (electron transporting layer), EML (light-emitting layer), HTL (hole transporting layer), HIL (Hole injecting layer), and the second electrode serving as an anode is preferably employed in consideration of the direction of moving electrons.

[0207]

As a passivation film for covering the second electrode, an insulating film may be formed using DLC or the like by a sputtering method or a CVD method. As a result, moisture or oxygen can be prevented from penetrating. Further, oxygen or moisture can be prevented from penetrating by covering the side of a display means by the first electrode, the second electrode, or another electrode. Then, the sealing substrate is pasted. The space formed by the sealing substrate may be filled with nitrogen or provided with drying agent. In addition, the space formed by the sealing substrate may be filled with resin having a light-emitting property and a high water absorption property.

[0208]

In addition, to increase contrast, a polarized plate or a circular polarized plate may be provided. For example, a polarized plate or a circular polarized plate can be provided over a surface or both surfaces of the display surface.

[0209]

In the light-emitting device having the structure formed as mentioned above, a material having a light-transmitting property (ITO or ITSO) is used for the first electrode and the second electrode in this example. Therefore, light is emitted from the electroluminescent layer in both directions 1305 and 1306 denoted by arrows at luminance corresponding to a video signal inputted from a signal line.

[0210]

In addition, FIG. 12 (B) illustrates another structure example that is partly different from that illustrated in FIG. 12 (A).

[0211]

In a structure of a light-emitting device illustrated in FIG. 12 (B), a channel etching n-channel TFT is provided for the driver circuit portion 1310 and the pixel portion 1311.

[0212]

A method for manufacturing the channel etching TFT is explained in Embodiment 1, and detailed description thereof is omitted here.

[0213]

As is the case with FIG. 12 (A), an n-channel TFT connected to a light-emitting element formed in the pixel portion 1311 is denoted to as a drive TFT 1301. The structure illustrated in FIG. 12 (B) differs from that illustrated in FIG. 12 (A) on the point that the first electrode is formed by using a conductive film having a non light transmitting property and preferably having a high light reflecting property, and the second electrode 1304 is formed by using a conductive film having a light transmitting property. Therefore, the emitting direction 1305 of light is only at the side of the sealing substrate.

[0214]

In addition, FIG. 12 (C) illustrates another structure example that is partly different from that illustrated in FIG. 12 (A).

[0215]

In a structure of a light-emitting device illustrated in FIG. 12 (C), a channel stop n-channel TFT is provided in the driver circuit portion 1310 and the pixel portion 1311.

[0216]

A method for manufacturing the channel stop TFT is explained in Embodiment 5, and detailed description thereof is omitted here.

[0217]

As in the case of FIG. 12 (A), an n-channel TFT connected to a light-emitting element formed in the pixel portion 1311 is denoted to as a drive TFT 1301. The structure illustrated in FIG. 12 (C) differs from that illustrated in FIG. 12 (A) on the

point that the first electrode is formed by using a conductive film having a light transmitting property, and the second electrode 1304 is formed by using a conductive film having a non light transmitting property and preferably having a high light reflecting property. Therefore, the emitting direction 1306 of light is only at the side of the substrate.

[0218]

As described above, the structure of a light-emitting device using each thin film transistor is explained. The constitution of the thin film transistor and the structure of the light-emitting device can be freely combined with each other.

[0219]

In addition, this example can be freely combined with any one of Embodiments 1 to 6 and Example 1.

[Example 3]

[0220]

The structure of a pixel of an EL display panel is explained with reference to an equivalent circuit diagram illustrated in FIG. 13 in this example.

[0221]

A pixel illustrated in FIG. 13 (A) is provided with a signal line 1410 and power lines 1411 to 413 in column direction, and a scanning line 1414 in a row direction. In addition, a switching TFT 1401, a drive TFT 1403, a current control TFT 1404, a capacitor element 1402, and a light-emitting element 1405 are provided.

[0222]

A pixel illustrated in FIG. 13 (C) has the same structure as that of the pixel illustrated in FIG. 13 (A) except the point that a gate electrode of a TFT 1403 is connected to a power line 1415 arranged in row direction. That is, both pixels illustrated in FIG. 13 (A) and FIG. 13 (C) show the same equivalent circuit diagrams. However, in the case of arranging the power line 1412 in row direction (FIG. 13 (A)) and in the case of arranging the power line 1412 in column direction (FIG. 13 (C)), each of the power lines is formed by using a conductive layer of a different layer. Here, wirings connected with the gate electrode of the drive TFT 1403 are focused and illustrated separately in FIG. 13 (A) and FIG. 13 (C) to show that the wirings are formed in different layers.

[0223]

As characteristics of pixels illustrated in FIG. 13 (A) and FIG. 13(C), the points that the TFTs 1403 and 1404 are connected with each other in series in the pixel, and a channel length L_3 and a channel width W_3 of the TFT 1403; and a channel length L_4 and a channel width W_4 of a TFT 1404 are set to meet L_3/W_3: L_4/W_4 = 5 ~ 6000: 1 are given. As an example in the case that lengths and widths meet 6000: 1, L_3 may be 500 μm; W_3, 3 μm; L_4, 3 μm; and W_4, 100 μm.

[0224]

Further, the TFT 1403 operates in a saturation region to control a current value flowing into the light-emitting element 1406, whereas the TFT 1404 operates in a linear region to control current supply to the light-emitting element 1406. The both TFTs have preferably the same conductive types in terms of a manufacturing process. In addition, as the TFT 1403, not only an enhancement TFT but also a depletion TFT can be used. According to the present invention having the foregoing structure, a slight variation of V_{GS} of the TFT 1404 does not affect the current value of the light-emitting element 1406 since the TFT 1404 operates in a linear region. That is, the current value of the light-emitting element 1406 is determined by the TFT 1403 operating in a saturation region. According to the present invention having the forgoing structure, a display device in which unevenness of luminance due to variations of characteristics of a TFT is improved and image quality is also improved can be provided.

[0225]

In pixels illustrated in FIG. 13 (A) to FIG. 13(D), the TFT 1401 controls input of a video signal to the pixel. Upon the TFT 1401 turning ON and inputting a video signal to the pixel, the video signal is stored in the capacitor element 1402. Note that FIG. 13 (A) and FIG. 13 (C) illustrate the structure of having the capacitor element 1402, however, the present invention is not limited thereto. In the case that the capacity for storing the video signal can be covered by gate capacitor or the like, the capacity element 1402 is not required to be expressly provided.

[0226]

The light-emitting element 1406 has the structure composed of two electrodes and an electroluminescent layer interposed between the two electrodes. In order to apply forward bias voltage, an electric potential difference is provided between a pixel

electrode and an opposing electrode (between an anode and a cathode). The electroluminescent layer is formed by using various materials such as an organic material or an inorganic material. Luminescence generated from the electroluminescent layer is light emission (fluorescence) produced in returning from the singlet excited state to the ground state, and light emission (phosphorescence) produced in returning from the triplet excited state to the ground state.

[0227]

A pixel illustrated in FIG. 13 (B) has the same pixel structure as that of the pixel illustrated in FIG. 13 (A) except the point that a TFT 1406 and the scanning line 1416 are provided. Similarly, a pixel illustrated in FIG. 13 (D) has the same structure as that of the pixel illustrated in FIG. 13 (C) except the point that the TFT 1406 and the scanning line 1416 are provided.

[0228]

ON/OFF of the TFT 1406 is controlled by the scanning line 1416 that is newly provided. Upon the TFT 1406 turning ON, charges stored in the capacitor element 1402 are discharged and the TFT 1406 is turned OFF. That is, it is possible to make compellingly the state that current does not flows through the light-emitting element 1405 by the arrangement of the TFT 1406. Therefore, duty ratio can be improved, since the structures illustrated in FIG. 13 (B) and FIG. 13 (D) can start a light period simultaneously with or soon after the start of a write period without waiting for the write of signals into all of pixels.

[0229]

A pixel illustrated in FIG. 13 (E) is provided with a signal line 1450 and power lines 1451 and 1452 in column direction, and a scanning line 1453 in row direction. In addition, the pixel includes a switching TFT 1441, a drive TFT 1443, a capacitor element 1442, and a light-emitting element 1444. A pixel illustrated in FIG. 13 (F) has the same pixel structure as that of the pixel illustrated in FIG. 13 (E) except the point that a TFT 1445 and a scanning line 1454 are provided. Further, the structure of FIG. 13 (F) can improve duty ratio by the arrangement of the TFT 1445.

[0230]

In addition, this example can be freely combined with any one of Embodiments 1 to 6 and Example 1 and Example 2.

[Example 4]

[0231]

A display module is explained in this example. As an example of the display module, a cross-sectional view of a light emission display module is explained using FIG. 14.

[0232]

FIG. 14 (A) illustrates a cross-section of a light emission display module in which an active matrix substrate 1201 and an opposing substrate 1202 are secured by sealant 1200. A pixel portion 1203 is provided between the active matrix substrate 1201 and the opposing substrate 1202 to form a display region.

[0233]

A space 1204 is formed between the opposing substrate 1202 and the pixel portion 1203. The space is filled with an inert gas, for example, a nitrogen gas; or provided with a resin having a light transmitting property and high water absorbing property, accordingly, moisture or oxygen can be further prevented from penetrating. Alternatively, resin having a light transmitting property and a high water absorbing property can be formed. Even if light generated from a light-emitting element is emitted to a second substrate side by resin having light transmitting property, a display module can be formed without reducing transmittance.

[0234]

In addition, to increase contrast, a polarized plate or a circular polarized plate (polarized plate, and 1/4λ plate and 1/2λ plate) may be provided for at least the pixel portion of the module. In the case that display is recognized from the side of the sealing substrate 1202 side, 1/4λ plate and 1/2λ plate 1205, and a polarized plate 1206 may be preferably provided sequentially from the sealing substrate 650 side. Moreover, an antireflection film may be provided over the polarized plate.

[0235]

Further, similarly, in the case that display is recognized from both sides of the sealing substrate 1202 and the active matrix substrate 1201, 1/4λ plate and 1/2λ plate, and a polarized plate are preferably provided over the surface of the active matrix substrate.

[0236]

A wiring substrate 1210 is connected to a connecting terminal 1208 provided for the active matrix substrate 1201 via an FPC 1209. The FPC or a connecting wiring is provided with a pixel driver circuit (IC chip, driver IC, or the like) 1211 and the wiring substrate 1210 is installed with an external circuit 1212 such as a control circuit or a power circuit.

[0237]

In addition, as illustrated in FIG. 14 (B), a colored layer 1207 can be provided between the pixel portion 1203 and the polarized plate, or between the pixel portion and the circular polarized plate. In this instance, full color display becomes possible by providing a light-emitting element capable of exhibiting white emission for the pixel portion and providing separately a colored layer exhibiting RGB. Alternatively, full color display becomes possible by providing a light-emitting element capable of exhibiting blue emission in the pixel portion and providing separately a color conversion layer or the like. Further alternatively, full color display becomes possible by providing a light-emitting element capable of exhibiting red, green, and blue emission and providing a colored layer in each pixel portion. Such a display module can display high-definition images with good color purity of each of RGB.

[0238]

In FIG. 14 (C), contrary to FIG. 14 (A), the active matrix substrate and the light-emitting element are sealed by using a protective film 1221 of a film, resin, or the like without using an opposing substrate. The protective film 1221 is provided to cover a second pixel electrode of the pixel portion 1203. As a second protective film, an organic material such as epoxy resin, urethane resin, or silicone resin can be used. In addition, the second protective film may be formed by dropping a polymer material by a droplet discharging method. In this example, the second protective film is formed by discharging epoxy resin by a dispenser and drying. Moreover, an opposing substrate may be provided over the protective film. The other structures are the same as those illustrated in FIG. 14 (A).

[0239]

By sealing without using an opposing substrate as described above, a display device can be reduced in its weight, size, and thickness.

[0240]

In the module according to this example, a printed substrate 1210 is mounted by using the FPC 1209; however, the present invention is not limited to this structure. The pixel driver circuit 1211 and the external circuit 1212 may be directly mounted on the substrate by a COG (Chip On Glass) method.

[0241]

In addition, this example can be freely combined with any one of Embodiments 1 to 6 and Examples 1 to 3.

[Example 5]

[0242]

In this example, a drying agent of a display panel explained in the foregoing example is explained with reference to FIG. 15.

[0243]

FIG. 15 (A) is a top view of a display panel. FIG. 15 (B) is a cross-sectional view of FIG. 28 (A) taken along (A)-(B), whereas FIG. 15 (C) is a cross-sectional view of FIG. 15 (A) taken along (C)-(D).

[0244]

As illustrated in FIG. 15 (A), an active matrix substrate 1800 and an opposing substrate 1801 are sealed by sealant 1802. A pixel region is provided between a first substrate and a second substrate. In the pixel region, a pixel 1807 is provided at a crossing region of a source wiring 1805 and a gate wiring 1806. A drying agent 1804 is provided between the pixel region and the sealant 1802. In addition, in the pixel region, a gate wiring or a source wiring is provided, and the drying agent 1814 is provided at the top portion. Note that here, the drying agent 1814 is provided over the gate wiring; however, the drying agent 1814 can also be provided over the gate wiring and the source wiring.

[0245]

As the drying agent 1804, a substance that adsorbs water (H_2O) by chemical adsorption such as oxides of alkali earth metal such as calcium oxide (CaO) or barium oxide (BaO) is preferably used. Alternatively, a substance that adsorbs water by physical adsorption such as zeolite or silica gel can be used.

[0246]

In addition, a drying agent can be contained in resin having high moisture permeability in the granular state to be secured to the substrate. Here, as the resin

having high moisture permeability, for example, acrylic resin such as ester acrylate, ether acrylate, ester urethane acrylate, ether urethane arylate, butadiene urethane acrylate, peculiarity urethane acrylate, epoxy acrylate, amino resin acrylate, or acrylic resin acrylate can be used. Besides, epoxy resin such as bisphenol A type liquid resin, bisphenol A type solid resin, bromine containing epoxy resin, bisphenol F type resin, bisphenol AD type resin, phenol resin, cresol resin, novolac resin, cyclic aliphatic epoxy resin, epi-bis epoxy resin, glycidyl ester resin, glycidyl amine based resin, heterocyclic epoxy resin, or modified epoxy resin can be used. Further, another substance can be used. In addition, for example, an inorganic substance such as siloxane can be used.

[0247]

Further, as the substance having a water absorbing property, a composite that is formed by mixing molecules that can adsorb water by chemical adsorption into organic solvent to be solidified or the like can be used.

[0248]

Note that as the foregoing inorganic substances or resin having high moisture permeability, a substance having higher moisture permeability than that of a substance used as the foregoing sealant is preferably selected.

[0249]

In the above-mentioned light-emitting device according to the present invention, water which penetrated the light-emitting device from outside can be absorbed before reaching the region provided with a light-emitting element. As a result, an element provided in a pixel, typically, a light-emitting element can be prevented from being damaged due to water.

[0250]

As illustrated in FIG. 15 (B), the drying agent 1804 is provided between the sealant 1802 and the pixel region 1803 at the periphery of the display panel. In addition, a concave portion is provided for the active matrix substrate or the opposing substrate to provide the drying agent 1804. Accordingly, the display panel can be manufactured to be thin.

[0251]

In addition, as illustrated in FIG. 15 (C), a pixel 1801 is provided with a semiconductor region 1811 that is a part of a semiconductor element for driving a

display element; a gate wiring 1806; a source wiring 1805; and a pixel electrode 1812. In the pixel portion of the display panel, the drying agent 1805 is provided on the opposing substrate in a region to be overlapped with the gate wiring 1806. Since the width of the gate wiring is two to four times larger than that of the source wiring, aperture ratio is not reduced and water penetration to the display element and deterioration due to water penetration can be restricted by providing the drying agent 1814 over the gate wiring 1816 that is a non display region. In addition, the display panel can be thinned by providing a concave portion for the opposing substrate and a drying agent in the concave portion.

[0252]

In addition, this example can be freely combined with any one of Embodiments 1 to 6, and Examples 1 to 4.

[Example 6]

[0253]

As a light-emitting display device and an electric appliance according to the invention, a video camera, a digital camera, a goggles-type display (head mount display), a navigation system, a sound reproduction device (a car audio equipment, an audio set and the like), a notebook personal computer, a game machine, a portable information terminal (a mobile computer, a cellular phone, a portable game machine, an electronic book, or the like), an image reproduction device including a recording medium (more specifically, a device which reproduces a recording medium such as a digital versatile disc (DVD) and has a display for displaying the reproduced image), or the like can be given. In particular, it is desirable to apply the present invention to a large-sized TV or the like having a large screen. FIG. 17 shows specific examples of such electric appliances.

[0254]

FIG. 17 (A) illustrates a large display device having a large screen of 22 inches ~ 50 inches comprising a housing 2001, a support table 2002, a display portion 2003, a video input terminal 2005, and the like. Note that the display device includes all of the display devices for displaying information, such as a personal computer, a receiver of TV broadcasting, and bi-directional TV. According to the present invention, a comparatively low price large display device can be realized even if a glass substrate of

generation five and the subsequent generation having a length of over 1000 mm on a side is used.

[0255]

FIG. 17 (B) illustrates a notebook personal computer comprising a main body 2201, a housing 2202, a display portion 2203, a key board 2204, an external connecting port 2205, a pointing mouse 2206, and the like. According to the present invention, a comparatively low price notebook personal computer can be realized.

[0256]

FIG. 17 (C) illustrates a portable image reproduction device including a recording medium (specifically, a DVD reproduction device) comprising a main body 2401, a housing 2402, a display portion A 2403, a display portion B 2404, a recording medium (DVD and the like) reading portion 2405, operation keys 2406, a speaker portion 2407, and the like. The display portion A 2403 displays mainly image information, whereas the display portion B 2404 displays mainly text information. Note that the image reproduction device including a recording medium includes a domestic game machine and the like. According to the present invention, a comparatively low price image reproduction device can be realized.

[0257]

FIG. 17 (D) illustrates a TV having a wireless portable display. A housing 2602 is installed with a battery and a signal receiver, in which the battery drives a display portion 2604 and a speaker portion 2607. The battery has a charger 2600 capable of being charged repeatedly. In addition, the charger 2600 can send and receive image signals, and send the image signals to a signal receiver of the display. The housing 2602 is controlled by operation keys 2606. Also, the device illustrated in FIG. 17 (D) may be referred to as an image sound two-way communication device since signals can be sent from the housing 2602 to the charger 2600. Further, the TV can control communications of another electric appliance by sending a signal from the housing 2602 to the charger 2600 by operating the operation keys 2606 and by receiving signals that can be sent by the charger 2600 by another electric appliance. Accordingly, the TV may also be referred to as a versatile remote control device. According to the present invention, a comparatively large (22 inches ~ 50 inches) portable TV can be provided by low cost manufacturing processes.

[0258]

As mentioned above, a light-emitting display device, which is obtained by practicing the present invention, can be used as a display portion of various kinds of electronic appliance.

[0259]

In addition, this example can be freely combined with any one of Embodiments 1 to 6, and Examples 1 to 5.

[Industrial Applicability]

[0260]

According to the present invention, a patterning process can be shortened and an amount of materials used can be reduced in a manufacturing process for a light-emitting display device for forming a conductive pattern. Therefore, the costs can be drastically reduced regardless of the substrate size.

[Brief Description of the Drawings]

[0261]

[FIG. 1] Cross-sectional views for showing a manufacturing process of an AM-LCD.

[FIG. 2] Cross-sectional views for showing a manufacturing process of an AM-LCD.

[FIG. 3] A view for showing a top view of a pixel.

[FIG. 4] A view for showing a laser beam drawing device.

[FIG. 5] Views for showing a manufacturing process. (Embodiment 2)

[FIG. 6] Views for showing a manufacturing process. (Embodiment 3)

[FIG. 7] Views for showing a manufacturing process. (Embodiment 4)

[FIG. 8] A cross-sectional view of a channel stop TFT (Embodiment 5)

[FIG. 9] A cross-sectional view of a staggered TFT. (Embodiment 6)

[FIG. 10] A top view showing a light-emitting display device according to the present invention. (Embodiment 1)

[FIG. 11] A top view showing a light-emitting display device according to the present invention. (Example 1)

[FIG. 12] Cross-sectional view for showing examples of a light-emitting display device. (Example 2)

[FIG. 13] Explanatory circuit diagrams for a structure of a pixel that can be applied to an EL display panel according to the present invention. (Example 3)

[FIG. 14] Cross-sectional views of a light-emitting display module. (Example 4)

[FIG. 15] A top view and cross-sectional views of a display panel. (Example 5)

[FIG. 16] A perspective view for showing a droplet discharging device.

[FIG. 17] Views for showing examples of an electronic appliance. (Example 6)

[Explanation of Reference]

[0262]

10: substrate

11: base layer

12: conductive film pattern

15: gate electrode

[Name of Document] Drawings

[FIG. 1] (A) 11: base layer (TiOx)

(B) Selective laser irradiation

(C)

(D) Formation of semiconductor film

18: gate insulating film, 19: semiconductor film, 20: semiconductor film (n+), 21: mask

(E) Formation of SD wirings

Terminal portion, pixel portion

[FIG. 2] (A) Etching of semiconductor film

(B) Formation of protective film

(C) Formation of interlayer insulating film, connection electrode, and anode

(D)

Terminal portion, pixel portion

[FIG. 3]

[FIG. 4] 401: laser beam direct drawing device

402: personal computer

403:laser oscillator

404: power source

405: optical system

406: acoustooptical modulator

407: optical system

408: substrate

409: substrate moving mechanism

410: D/A conversion portion

411: driver

412: driver

[FIG. 5] (A) Dropping

(B) Exposure to laser light

(C) Formation of SD wirings by developing

(D) Etching

Terminal portion, pixel portion

[FIG. 6] (A) Dropping

(B) Exposure to laser light

(C) Formation of SD wirings by developing

(D) Etching

Terminal portion, pixel portion

[FIG. 7] (A) Dropping

(B) Exposure of reverse surface to laser light

(C) Formation of SD wirings by developing

(D) Etching

[FIG. 8] Terminal portion, pixel portion

[FIG. 9] Terminal portion, pixel portion

[FIG. 10]

[FIG. 11]

[FIG. 12]

[FIG. 13]

[FIG. 14] 1200: sealant, 1201: active matrix substrate, 1202: opposing substrate, 1203: pixel portion, 1204: space, 1205: 1/4λ plate and 1/2λ plate, 1206: polarized plate, 1207: colored layer, 1208: connecting terminal, 1209: FPC, 1210: printed substrate, 1211: pixel driver circuit, 1212: external circuit, 1221: protective film

[FIG. 15]

[FIG. 16]

[FIG. 17] (A) 2003: display portion, 2001: housing, 2005: video input terminal, 2002:

support table

(B) 2202: housing, 2203: display portion, 2201: main body, 2204: keyboard, 2205: external connecting port, 2206: pointing mouse

(C) 2403: display portion A, 2402: housing, 2401: main body, 2405: recording medium reading portion, 2404: display portion B, 2406: operation key, 2407: speaker portion

(D) 2602: housing, 2603: display portion, 2606: operation key, 2607: speaker portion, 2600: charger (capable of sending and receiving)

[Name of Document] Abstract

[Abstract]

[Object]

In the present circumstances, a film formation method of using a spin coating method is heavily used in a manufacturing process. As increasing the substrate size in future, the film formation method of using a spin coating method becomes a disadvantage in mass production since a mechanism for rotating a large substrate becomes large, and there are many loss of material solution and waste liquid.

[Solving Means]

According to the present invention, in a manufacturing process of a light-emitting display device, a microscopic wiring pattern can be realized by discharging selectively photosensitive conductive material solution by a droplet discharging method, exposing selectively to laser light or the like, and developing. The present invention can reduce drastically costs since a patterning process can be shortened and an amount of material used in a process of forming a conductive pattern can be reduced. Accordingly, the present invention can be applied to a large substrate.

[Selected Drawing] FIG. 1